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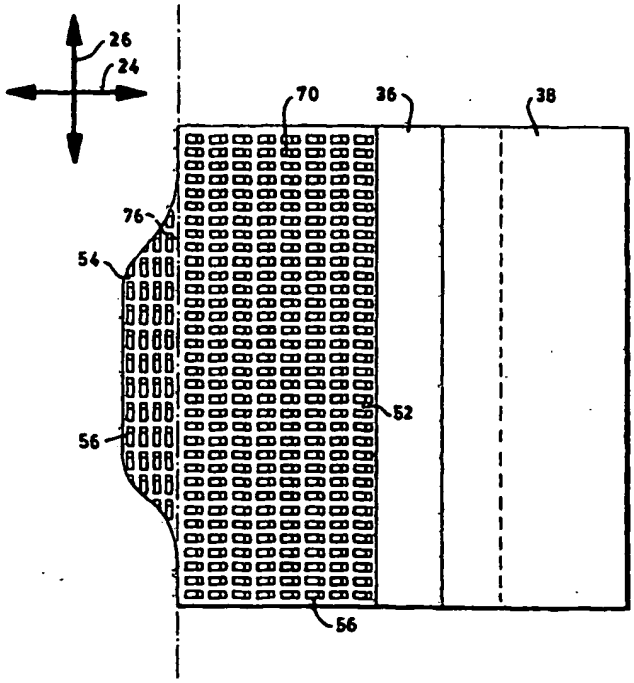
(54) Title: MECHANICAL FASTENING SYSTEM HAVING SECTIONS WITH ARRANGED ENGAGEMENT MEMBERS

(57) Abstract

An article has a lengthwise, longitudinal direction (26), a lateral cross-direction (24), a longitudinally extending medial line (40), a first article portion (12), a second article portion (14) and at least one fastener (36) for securing the article on a wearer. The fastener (36) includes at least one first fastener component (70) attached to a lateral side section (86) of the first article portion, and a cooperating, second fastener component (72) attached to the second article portion. The first fastener component (70) includes a first engagement section (52) having a first plurality of non-isotropic engagement members (56), and a second engagement section (54) having a second plurality of non-isotropic engagement members. A longitudinally extending, fastener transition region (76) may be located between laterally adjacent regions of the first and second engagement sections. Each non-isotropic engagement member (56) has a stem portion (58), and a securement element (60) which is non-isotropically disposed at a distal end region of its corresponding stem portion (58) to provide a non-isotropic engagement opening. A majority of the first plurality of non-isotropic engagement members can have their engagement openings directed substantially along a first vector which has a cross-directional vector-component directed along the lateral direction (24). A majority of the second plurality of non-isotropic engagement members can have their engagement openings directed substantially along a second vector which is directed away from the first vector by a selected offset.



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MECHANICAL FASTENING SYSTEM HAVING SECTIONS WITH ARRANGED ENGAGEMENT MEMBERS

Field of the Invention

The present invention relates to fastening systems for garments and other articles. More particularly, the present invention relates to interlocking, mechanical-type fastening systems which can be employed with disposable articles, such as gowns, diapers, incontinence garments and the like.

Background of the Invention

Conventional disposable absorbent articles have typically employed adhesive fastening tapes for securing the article on a wearer. Such articles have also been constructed with interengaging mechanical fasteners, such as VELCRO brand hook-and-loop fasteners. Particular articles have included a fastening system which has extended along substantially the entire length of an ear section of the article. Other fastening systems have included strips or segmented sections of adhesive. Still other systems have included strips or segmented sections of selected mechanical fastener components, such as individual sections of hook material. In addition, various types of hook materials, such as inverted-J shaped, T-shaped and generally mushroom-shaped hooks have been employed. Conventional fastening systems have also employed tapered fastening tabs where the attaching area on the user's end is relatively wide at its region adjacent the longitudinally extending sides of the diaper, and is tapered to a more narrow width at its more remote distal end. For example, see European patent EP 0 233 704 B1 of H. Burkhard et al.

Conventional fasteners and fastening systems, such as those described above, have not provided an adequate level of dynamic fit in combination with a neat tailored appearance, reliable securement and ease of unfastening. The conventional fastening systems have not provided a sufficient capability to accommodate the stresses imposed by fastening the article on a wearer, while accommodating the other stresses and displacements caused by a moving wearer and also providing a desired ease of selective unfastening and removal. As a result, the conventional fastening systems have not provided desired levels of comfort, securement, ease of manufacture and ease of use.

Brief Description of the Invention

Generally stated, the present invention provides a distinctive article, having a lengthwise longitudinal direction, a lateral cross-direction, and a longitudinally extending medial line. The article includes a first article portion, a second article portion, and at least one fastener for securing the first article portion to the second article portion. The fastener includes at least one, first fastener component attached to an appointed section of the first article portion, and a cooperating, second fastener component attached to the second article portion. The first fastener component includes a first engagement section having a first plurality of engagement members, and a second engagement section having a second plurality of engagement members. Each engagement member has a stem portion with a distal end region, and has a securement element disposed at its distal end region. The first plurality of engagement members have a first arrangement pattern of their securement elements, and the second plurality of engagement members has a second arrangement pattern of their securement elements, with the second arrangement pattern differing from the first arrangement pattern.

In particular aspects, the invention can provide an article which includes a lengthwise, longitudinal direction, a lateral cross-direction, a longitudinally extending medial line, a first article portion, a second article portion and at least one fastener for securing said first article portion to said second article portion. The fastener includes a first engagement section having a first plurality of non-isotropic engagement members, and a second engagement section having a second plurality of non-isotropic engagement members. Each non-isotropic engagement member can have a stem portion with a distal end portion, and can have a non-isotropic securement element disposed at the distal end region of its corresponding stem portion to provide a non-isotropic engagement opening. The first plurality of non-isotropic engagement members can have a first alignment pattern of their engagement openings, and the second plurality of non-isotropic engagement members can have a second alignment pattern of their engagement openings, with the second alignment pattern differing from the first alignment pattern.

In particular configurations, a majority of the first plurality of non-isotropic engagement members have their engagement openings directed substantially along a first vector which has a first, cross-directional vector-component directed along the lateral direction and toward the medial line of the article. A majority of the second plurality of non-isotropic engagement members have their engagement openings directed substantially along a

second vector which is directed away from the first cross-directional vector-component. Desirably, the second vector is directed away from the first cross-directional vector-component by an angle which is at least about ± 45 degrees.

In another aspect, the invention can provide an article which includes a lengthwise, longitudinal direction, a lateral cross-direction, a longitudinally extending medial line, a first article portion, a second article portion and at least one fastener for securing said first article portion to said second article portion. The fastener includes at least one first fastener component attached to the first article portion, and a cooperating, second fastener component attached to the second article portion. The first fastener component can include a first engagement section having a first plurality of symmetric and/or non-symmetric engagement members, and a second engagement section having a second plurality of symmetric and/or non-symmetric engagement members. In a desired arrangement, for example, the first engagement section can have a first plurality of non-symmetric engagement members, and the second engagement section can have a second plurality of non-symmetric engagement members. Each non-symmetric engagement member has a stem portion, and a non-symmetric securement element which is disposed at a distal end region of its corresponding stem portion to provide an asymmetric, primary engagement opening. The first plurality of non-symmetric engagement members can have a first alignment pattern of their engagement openings, and the second plurality of non-symmetric engagement members can have a second alignment pattern of their engagement openings, with the second alignment pattern differing from the first alignment pattern.

In particular configurations, a majority of the first plurality of non-symmetric engagement members can have their asymmetric engagement openings directed substantially along a first vector which has a first cross-directional vector-component directed along the lateral direction and toward the medial line of the article. A majority of the second plurality of non-symmetric engagement members can have their asymmetric engagement openings directed substantially along a second vector which is directed away from the first cross-directional vector-component. In particular configurations, the second vector is directed away from the first cross-directional vector-component by an angle of at least ± 45 degrees. In further aspects, the second vector may have a second cross-directional vector-component directed along the lateral direction and away from the medial line of the article.

In still other aspects, a fastener transition region may be located between adjacent regions of selected engagement sections. A majority of the first plurality of non-symmetric engagement members have their asymmetric engagement openings directed substantially along a first vector which has a first selected alignment with the fastener transition region. A majority of the second plurality of non-symmetric engagement members have their asymmetric engagement openings directed substantially along a second vector which has a different, second selected alignment with the fastener transition region.

The incorporation of the various aspects of the fastening system of the invention can provide improved securement with greater resistance to premature pop-opens, and can also provide improved fit, greater comfort, and reduced irritation of the wearer's skin. The distinctively configured engagement zones and/or engagement members can provide an improved combination of high engagement areas for greater securement and fastener reliability, and predetermined areas of relatively lesser engagement for ease of unfastening and removal of the article from a wearer.

Brief Description of the Drawings

The present invention will be more fully understood and further advantages will become apparent when reference is made to the following detailed description of the invention and the drawings, in which:

Fig. 1 representatively shows a partially cut-away, top view of an inward side of a diaper article which incorporates the fastening system of the invention;

Fig. 2 representatively shows a top, plan view of an outward side of a diaper article which incorporates the fastening system of the invention;

Fig. 3 representatively shows a schematic, longitudinal cross-sectional view of the article illustrated in Fig. 1;

Fig. 4 representatively shows a side view of a generally T-shaped, non-isotropic engagement member which can be employed with the present invention;

Fig. 4A representatively shows a top view of the engagement member of Fig. 4;

Fig. 5 representatively shows a side view of another non-isotropic engagement member having an oval-shaped securement element which can be employed with the present invention;

Fig. 5A representatively shows a top view illustrating the oval-shape of the securement element on the engagement member of Fig. 5;

Fig. 6 representatively shows a side view of another non-isotropic engagement member having an oval-shaped securement element with a more pronounced downward curvature;

Fig. 6A representatively shows a top view illustrating the oval-shape of the securement element on the engagement member of Fig. 6;

Fig. 7 representatively shows a side view of still another non-isotropic engagement member having a multiple prong securement element in which the prongs face opposite each other and are offset side-by-side;

Fig. 7A representatively shows a top view of the engagement member of Fig. 7;

Fig. 8 representatively shows a side view of a non-symmetric, J-shaped engagement member;

Fig. 8A representatively shows a top view of the non-symmetric, J-shaped engagement member of Fig. 8;

Fig. 9 representatively shows an isometric view of the engagement member of Fig. 8;

Fig. 10 representatively shows a side view of another non-symmetric engagement member having an oval-shaped securement element;

Fig. 10A representatively shows a top view of the engagement member of Fig. 10, which illustrates the oval-shape of the securement element;

Fig. 11 representatively shows a top view of a side panel ear region and fastening tab assembly of the invention having non-isotropic and non-symmetric engagement members;

Fig. 11A representatively shows a schematic, laterally extending, expanded edge view of the fastening tab assembly of Fig. 11;

Fig. 11B representatively shows a top view of a side panel ear region and fastening tab assembly of the invention having another arrangement of non-isotropic and non-symmetric engagement members;

Fig. 11C representatively shows a schematic, laterally extending, expanded edge view of the fastening tab assembly of Fig. 11B;

Fig. 11D representatively shows a top view of a side panel ear region and fastening tab assembly of the invention having non-isotropic and generally symmetric engagement members;

Fig. 11E representatively shows a schematic, laterally extending, expanded edge view of the fastening tab assembly of Fig. 11D;

Fig. 12 representatively shows a relative, angular offset relationship between selected engagement members;

Fig. 13 representatively shows a top view of a side panel joined with another fastening tab assembly of the invention;

Fig. 13A representatively shows a schematic, laterally extending, expanded edge view of the fastening tab assembly illustrated in Fig. 13.

Detailed Description of the Invention

The various aspects and embodiments of the invention will be described in the context of a disposable absorbent article, such as a disposable diaper. It is, however, readily apparent that the present invention could also be employed with other articles, such as caps, gowns, shoe covers, feminine care articles, children's training pants, incontinence garments and the like. Typically, the disposable articles are intended for limited use and are not intended to be laundered or otherwise cleaned for reuse. A disposable diaper, for example, is discarded after it has become soiled by the wearer.

With reference to Figs. 1, 2, 3 and 4, an article, such as diaper 10 has a lengthwise, longitudinal direction 26, a lateral cross-direction 24, and a longitudinally extending medial line 40. The article includes a first article portion, a second article portion and at least one fastener 36 for securing the first article portion to the second article portion. Such securement can, for example, be configured to thereby hold the article on a wearer. The fastener desirably includes at least one, first fastener component 70 attached to an appointed section of the first article portion, and a cooperating, second fastener component 72 attached to the second article portion. The first fastener component 70 includes a first engagement section 52 having a first plurality of engagement members 56, and a second engagement section 54 having a second plurality of engagement members 56. Each engagement member 56 has a stem portion 58 with a distal end region 44, and has at least one securement element 60 disposed at its corresponding distal end region. The first plurality of engagement members has a first arrangement pattern of their securement elements; and the second plurality of engagement members has a second arrangement pattern of their securement elements, with the second arrangement pattern differing from the first arrangement pattern.

Another aspect of the invention can provide an article in which the first fastener component may include a first engagement section 52 having a first plurality of non-isotropic engagement members, and a second engagement section 54 having a second plurality of non-isotropic engagement members. Each non-isotropic engagement member can have a stem portion 58 with a distal end portion 44, and a direction-dependent securement element 60 which is non-isotropically disposed at the distal end region of its corresponding stem portion 58 to provide a non-isotropic engagement opening. The first plurality of non-isotropic engagement members can have a first alignment pattern of their engagement openings, and the second plurality of non-isotropic engagement members can have a second alignment pattern of their engagement openings, with the second alignment pattern differing from the first alignment pattern.

In particular configurations, a majority of the first plurality of non-isotropic engagement members have their engagement openings directed substantially along a first vector which has a first, cross-directional vector-component directed along the lateral direction 24 and toward the medial line 40 of the article. A majority of the second plurality of non-isotropic engagement members have their engagement openings directed substantially along a second vector which is directed away from the first cross-directional vector-component.

Desirably, the second vector is directed away from the first cross-directional vector-component by an angular offset difference which is at least about ± 45° (plus or minus 45 degrees).

In a further aspect, the first engagement section 52 of the first fastener component can have a first plurality of non-isotropic and/or non-symmetric engagement members, and the second engagement section 54 can have a second plurality of non-isotropic and/or non-symmetric engagement members. For example, the first engagement section can have a first plurality of non-isotropic, symmetric engagement members, and the second engagement section can have a second plurality of non-symmetric engagement members. Other combinations of the non-isotropic and non-symmetric engagement members may also be employed.

Each non-symmetric engagement member can have a stem portion 58 with a distal end portion 44, and a direction-dependent securement element 60 which is desirably asymmetrically disposed at the distal end region of its corresponding stem portion 58 to provide an asymmetric, primary engagement opening. The first plurality of non-symmetric engagement members can have a first alignment pattern of their engagement openings, and the second plurality of non-symmetric engagement members can have a second alignment pattern of their engagement openings, with the second alignment pattern differing from the first alignment pattern.

In particular configurations, a majority of the first plurality of non-symmetric engagement members can have their asymmetric engagement openings directed substantially along a first vector which has a first cross-directional vector-component directed along the lateral direction 24 and toward the medial line 40 of the article. Additionally, a majority of the second plurality of non-symmetric engagement members can have their asymmetric engagement openings directed substantially along a second vector which is directed with an angular offset away from the first cross-directional vector-component. The second vector is desirably directed away from the first cross-directional vector-component by an angular offset difference of at least ± 45 degrees In further aspects, the second vector may have a second cross-directional vector-component directed along the lateral direction 24 and away from the medial line 40 of the article.

In the various configurations of the invention, a fastener transition region 76 may be located between laterally adjacent regions of the first and second engagement sections 52

and 54. In addition, the first engagement section 52 may be positioned laterally inboard from the second engagement section 54 and relatively closer to the article medial line 40. Optionally, the first engagement section 52 may be positioned laterally outboard from the second engagement section 54. As representatively shown, the fastening system can provide the at least one first fastener component 70 attached to a lateral side section 86 of a first waistband portion 12 of the article, and can provide the cooperating, second fastener component 72 attached to an appointed section of the second waistband portion 14 of the article. Optionally, the at least one first fastener component 70 can be attached to a lateral side section 88 of the second waistband portion 14, and the cooperating, second fastener component 72 can be attached to an appointed section of the first waistband portion 12.

In the various aspects of the invention the distribution patterns of the engagement members and the alignment patterns of the associated securement elements and engagement openings are determined with respect to the first fastener component prior to its engagement to the appointed, complementary second fastener component. In desired aspects, the distribution patterns and alignment patterns are substantially maintained when the first and second fastener components are operatively inter-engaged. In addition, the individual engagement members are typically flexible and resilient, but will substantially retain their initial shape during ordinary use. When flexed or deformed during ordinary use, the engagement members will substantially avoid plastically deforming to sustain the deformation, and will, instead, substantially return or "spring-back" to their original orientations and shape.

In the various configurations of the invention, the desired demarcations between the appointed engagement sections (e.g. between engagement sections 52 and 54) can be abrupt or gradual. For example, adjacent engagement sections can be configured as distinct and separate area sections of the fastener component. The engagement sections can be abruptly and sharply delineated by a distinct line, space or other region of generally discontinuous separation, as representatively shown in the various Figures. Alternatively, the engagement sections can be gradually delimited by an interconnecting transition region wherein one or more of the desired structures or parameters of the individual engagement sections may continuously or continually change, in a substantially gradient manner, as one moves from one engagement section to another, adjacent engagement section.

The various aspects (individually and in combination) of the present invention can advantageously help to better maintain the desired fit around the wearer. For example, the aspects of the invention can help reduce the sagging and drooping of the crotch region of the garment, and can help reduce roll-over and drooping at the waist region. The incorporation of the various aspects of the fastening system of the invention can provide improved securement with greater resistance to premature pop-opens, and can also help provide improved fit, greater comfort and reduced irritation of the wearer's skin. The distinctively configured engagement zones and/or engagement members can provide a distinctive combination of high engagement areas for greater securement and reliability, and predetermined areas of relatively lesser engagement for greater ease in the unfastening and removal of the article from a wearer. In particular aspects, the amounts of peel strength and/or shear strength in selected areas can be controlled to provide desired combinations of securement. In other aspects, the distal or outboard end of the fastener tab can be more easily found, and can be more easily unfastened without employing a substantially unsecured finger lift tab.

The article of the invention can, for example, be a garment provided by the representatively shown disposable diaper 10. In desired aspects of the invention, the first article portion can provide a first, back waistband portion 12, and the second article portion can provide a second, front waistband portion 14. In addition, the article can have an intermediate or crotch portion 16 which interconnects between the first and second waistband portions 12 and 14, respectively. The diaper can further include a backsheet layer 30, a liquid permeable topsheet layer 28 connected and assembled in facing relation with the backsheet layer, and an absorbent structure, such as a structure which includes absorbent body 32. The absorbent structure is sandwiched between the backsheet and topsheet layers, and is operably held therebetween. A fastening system, such as the system including fasteners 36, is typically constructed and arranged to interconnect the first waistband portion 12 with the second waistband portion 14 to hold the article on a wearer. The fastening system can be operatively configured to join the first, back waistband portion 12 in an overlapping relation with the second, front waistband portion 14 in a back-to-front arrangement to thereby encircle the wearer's body and hold the diaper secure on the wearer during use. Optionally, the fastening system can employ fasteners 36 which are configured to join the front waistband portion 14 in an overlapping relation with the back waistband portion 12 in a front-to-back arrangement to secure the diaper. In such optional arrangements, the front waistband region may be identified as

the first waistband portion 12 and the rear waistband region may be identified as the second waistband portion 14.

As representatively shown, the front waistband section 14 of the diaper 10 has a laterally opposed, front pair of side edge regions 88, and the rear waistband section 12 has a laterally opposed, rear pair of side edge regions 86. The intermediate section 16 interconnects the front and rear waistband section and provides a diaper crotch region which is typically positioned between the legs of the wearer. The article has an appointed fastener landing zone member 50 which is disposed on the outward surface of the article. In the configuration shown in Figs. 1 and 2, for example, the landing member 50 is disposed on the outward surface of the backsheet layer 30. The liquid permeable topsheet layer 28 is superposed in facing relation with the backsheet layer 30, and the absorbent body 32 is operably connected and affixed between the backsheet layer 30 and topsheet layer 28.

Figs. 1 and 2 show typical plan views of the representative disposable diaper 10 in its generally flat-out, uncontracted state (i.e., with substantially all elastic induced gathering and contraction removed). In Fig. 1, portions of the structure are partially cut away to more clearly show the interior construction of the diaper article, and the bodyside surface of the diaper which contacts the wearer is facing the viewer. The outer edges of the diaper define a periphery with longitudinally extending side edge margins 20 and laterally extending end edge margins 22. The side edges define leg openings for the diaper, and optionally, are curvilinear and contoured. The end edges are shown as straight, but optionally, may be curvilinear.

With regard to the designated surfaces of the article, the various inward or bodyside surfaces are configured to face toward the body of the wearer when the article is placed about the wearer. The designated outward surfaces of the article are configured to face away from the wearer's body when the article is placed about the wearer.

The diaper 10 can typically include a porous, liquid permeable topsheet 28; a substantially liquid impermeable backsheet 30; an absorbent body structure 32 positioned and connected between the topsheet and backsheet; a surge management portion 46 located adjacent the absorbent structure; and a system of elastomeric gathering members, such as a system including leg elastics 34 and waist elastics 42. The surge management portion is positioned in a liquid communication with an appointed storage or retention

portion of the absorbent structure, and the topsheet 28, backsheet 30, absorbent structure 32, surge management portion 46 and elastic members 34 and 42 may be assembled together into a variety of well-known diaper configurations. The diaper can additionally include a system of containment flaps 62, and a system of side panel or ear region members 38, which may be elasticized or otherwise rendered elastomeric.

Examples of articles which include elasticized side panels and selectively configured fastener tabs are described in U.S. Patent Application Serial No. 168,615 of T. Roessler et al., entitled DYNAMIC FITTING DIAPER, and filed December 6, 1993 (attorney docket No. 10,961). Various techniques for forming the desired fastening systems are described in U.S. Patent No. 5,399,219 of T. Roessler et al., entitled METHOD FOR MAKING A FASTENING SYSTEM FOR A DYNAMIC FITTING DIAPER which issued March 21, 1995 (attorney docket No. 11,186); in U.S. Patent Application Serial No. 286,086 of D. Fries, entitled A PROCESS FOR ASSEMBLING ELASTICIZED EAR PORTIONS and filed August 3, 1994 (attorney docket No. 11,169) which corresponds to U.S. Patent No. 5,540,796; and in U.S. Patent Application Serial No. 08/415,383 of D. Fries, entitled AN ASSEMBLY PROCESS FOR A LAMINATED TAPE and filed April 3, 1995 (attorney docket No. 11,950) which corresponds to U.S. Patent No. 5,595,618. The disclosures of the above-described documents are incorporated herein by reference in a manner that is consistent (not in conflict) herewith.

The diaper 10 generally defines the longitudinally extending length direction 26 and the laterally extending width direction 24, as representatively shown in Figs. 1 and 2. The diaper may have any desired shape, such as rectangular, I-shaped, a generally hourglass shape, or a T-shape. With the T-shape, the crossbar of the "T" may comprise the front waistband portion of the diaper, or may alternatively comprise the rear waistband portion of the diaper.

The topsheet 28 and backsheet 30 may be generally coextensive, and may have length and width dimensions which are generally larger than and extend beyond the corresponding dimensions of the absorbent structure 32 to provide for the corresponding side margins 20 and end margins 22. Optionally, the topsheet and backsheet layers may not be coextensive. The topsheet 28 is operatively associated with and superimposed on backsheet 30, thereby defining the periphery of the diaper. The waistband regions comprise those portions of the diaper, which when worn, wholly or partially cover or encircle the waist or mid-lower torso of the wearer. The intermediate, crotch region 16

lies between and interconnects the waistband regions 14 and 12, and comprises that portion of the diaper which, when worn, is positioned between the legs of the wearer and covers the lower torso of the wearer. Thus, the intermediate crotch region 16 is an area where repeated fluid surges typically occur in the diaper or other disposable absorbent article.

The backsheet 30 can typically be located along an outer-side surface of the absorbent body 32 and may be composed of a liquid permeable material, but desirably comprises a material which is configured to be substantially impermeable to liquids. For example, a typical backsheet can be manufactured from a thin plastic film, or other flexible, substantially liquid-impermeable material. As used in the present specification, the term "flexible" refers to materials which are compliant and which will readily conform to the general shape and contours of the wearer's body. Backsheet 30 prevents the exudates contained in absorbent body 32 from wetting articles, such as bedsheets and overgarments, which contact diaper 10. In particular embodiments of the invention, backsheet 30 can include a film, such as a polyethylene film, having a thickness of from about 0.012 millimeters (0.5 mil) to about 0.051 millimeters (2.0 mils). For example, the backsheet film can have a thickness of about 1.25 mil.

Alternative constructions of the backsheet may comprise a woven or non-woven fibrous web layer which has been totally or partially constructed or treated to impart the desired levels of liquid impermeability to selected regions that are adjacent or proximate the absorbent body. For example, the backsheet may include a gas-permeable, nonwoven fabric layer laminated to a polymer film layer which may or may not be gas-permeable. Other examples of fibrous, cloth-like backsheet materials can comprise a stretch thinned or stretch thermal laminate material composed of a 0.6 mil (0.015 mm) thick polypropylene blown film and a 0.7 ounce per square yard (23.8 gsm) polypropylene spunbond material (2 denier fibers). A material of this type forms the outercover of a HUGGIES SUPREME disposable diaper, which is commercially available from Kimberly-Clark Corporation. The backsheet 30 typically provides the outer cover of the article. Optionally, however, the article may include a separate outer cover component member which is additional to the backsheet.

The backsheet 30 may alternatively include a micro-porous, "breathable" material which permits gases, such as water vapor, to escape from the absorbent body 32 while substantially preventing liquid exudates from passing through the backsheet. For

example, the breathable backsheet may be composed of a microporous polymer film or a nonwoven fabric which has been coated or otherwise modified to impart a desired level of liquid impermeability. For example, a suitable microporous film can be a PMP-1 material, which is available from Mitsui Toatsu Chemicals, Inc., a company having offices in Tokyo, Japan; or an XKO-8044 polyolefin film available from 3M Company of Minneapolis, Minnesota. The backsheet may also be embossed or otherwise provided with a pattern or matte finish to exhibit a more aesthetically pleasing appearance.

In the various configurations of the invention, where a component such as the backsheet 30 or the containment flaps 62 are configured to be permeable to gas while having a resistance and limited permeability to aqueous liquid, the liquid resistant material can have a construction which is capable of supporting a hydrohead of at least about 45 cm of water substantially without leakage therethrough. A suitable technique for determining the resistance of a material to liquid penetration is Federal Test Method Standard FTMS 191 Method 5514, 1978, or an equivalent thereof.

The size of the backsheet 30 is typically determined by the size of absorbent body 32 and the particular diaper design selected. Backsheet 30, for example, may have a generally T-shape, a generally I-shape or a modified hourglass shape, and may extend beyond the terminal edges of absorbent body 32 by a selected distance, such as a distance within the range of about 1.3 centimeters to 2.5 centimeters (about 0.5 to 1 inch), to provide at least a portion of the side and end margins.

The topsheet 28 presents a body-facing surface which is compliant, soft-feeling, and non-irritating to the wearer's skin. Further, the topsheet 28 can be less hydrophilic than absorbent body 32, and is sufficiently porous to be liquid permeable, permitting liquid to readily penetrate through its thickness to reach the absorbent body. A suitable topsheet layer 28 may be manufactured from a wide selection of web materials, such as porous foams, reticulated foams, apertured plastic films, natural fibers (for example, wood or cotton fibers), synthetic fibers (for example, polyester or polypropylene fibers), or a combination of natural and synthetic fibers. The topsheet layer 28 is typically employed to help isolate the wearer's skin from liquids held in absorbent body 32.

Various woven and nonwoven fabrics can be used for topsheet 28. For example, the topsheet may be composed of a meltblown or spunbonded web of the desired fibers, and

may also be a bonded-carded-web. The various fabrics can be composed of natural fibers, synthetic fibers or combinations thereof.

For the purposes of the present description, the term "nonwoven web" means a web of fibrous material which is formed without the aid of a textile weaving or knitting process. The term "fabrics" is used to refer to all of the woven, knitted and nonwoven fibrous webs.

The topsheet fabrics may be composed of a substantially hydrophobic material, and the hydrophobic material may optionally be treated with a surfactant or otherwise processed to impart a desired level of wettability and hydrophilicity. In a particular embodiment of the invention, topsheet 28 is a nonwoven, spunbond polypropylene fabric composed of about 2.8 - 3.2 denier fibers formed into a web having a basis weight of about 22 gsm and density of about 0.06 gm/cc. The fabric can be surface treated with an operative amount of surfactant, such as about 0.28% TRITON X-102 surfactant. The surfactant can be applied by any conventional means, such as spraying, printing, brush coating or the like.

The topsheet 28 and backsheet 30 are connected or otherwise associated together in an operable manner. As used herein, the term "associated" encompasses configurations in which topsheet 28 is directly joined to backsheet 30 by affixing topsheet 28 directly to backsheet 30, and configurations wherein topsheet 28 is indirectly joined to backsheet 30 by affixing topsheet 28 to intermediate members which in turn are affixed to backsheet 30. Topsheet 28 and backsheet 30 can, for example, be joined to each other in at least a portion of the diaper periphery by suitable attachment mechanisms (not shown) such as adhesive bonds, sonic bonds, thermal bonds, pinning, stitching or any other attachment technique known in the art, as well as combinations thereof. For example, a uniform continuous layer of adhesive, a patterned layer of adhesive, a sprayed pattern of adhesive or an array of separate lines, swirls or spots of construction adhesive may be used to affix the topsheet 28 to the backsheet 30. It should be readily appreciated that the above-described attachment means may also be employed to suitably interconnect, assemble and/or affix together the various other component parts of the articles which are described herein.

The absorbent body 32 provides an absorbent structure which can include a retention portion, such as the representatively shown absorbent pad composed of selected hydrophilic fibers and high-absorbency particles, for holding and storing absorbed liquids and other waste materials. The absorbent body is positioned and sandwiched between

the topsheet 28 and backsheet 30 to form the diaper 10. The absorbent body has a construction which is generally compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining body exudates. It should be understood that, for purposes of this invention, the absorbent body structure may comprise a single, integral piece of material, or alternatively, may comprise a plurality of individual separate pieces of material which are operably assembled together.

Various types of wettable, hydrophilic fibrous material can be used to form the component parts of absorbent body 32. Examples of suitable fibers include naturally occurring organic fibers composed of intrinsically wettable material, such as cellulosic fibers; synthetic fibers composed of cellulose or cellulose derivatives, such as rayon fibers; inorganic fibers composed of an inherently wettable material, such as glass fibers; synthetic fibers made from inherently wettable thermoplastic polymers, such as particular polyester or polyamide fibers; and synthetic fibers composed of a nonwettable thermoplastic polymer, such as polypropylene fibers, which have been hydrophilized by appropriate means. The fibers may be hydrophilized, for example, by treatment with silica, treatment with a material which has a suitable hydrophilic moiety and is not readily removable from the fiber, or by sheathing the nonwettable, hydrophobic fiber with a hydrophilic polymer during or after the formation of the fiber. For the purposes of the present invention, it is contemplated that selected blends of the various types of fibers mentioned above may also be employed.

As used herein, the term "hydrophilic" describes fibers or the surfaces of fibers which are wetted by the aqueous liquids in contact with the fibers. The degree of wetting of the materials can, in turn, be described in terms of the contact angles and the surface tensions of the liquids and materials involved. Equipment and techniques suitable for measuring the wettability of particular fiber materials or blends of fiber materials can be provided by a Cahn SFA-222 Surface Force Analyzer System, or a substantially equivalent system. When measured with such system, fibers having contact angles less than 90° are designated "wettable", while fibers having contact angles greater than 90° are designated "nonwettable".

The absorbent body structure 32 can comprise a matrix of hydrophilic fibers, such as a web of cellulosic fluff, mixed with particles of high-absorbency material. In particular arrangements, absorbent body 32 may comprise a mixture of superabsorbent hydrogel-forming particles and synthetic polymer meltblown fibers, or a mixture of superabsorbent

particles with a fibrous coform material comprising a blend of natural fibers and/or synthetic polymer fibers. The superabsorbent particles may be substantially homogeneously mixed with the hydrophilic fibers, or may be nonuniformly mixed. For example, the concentrations of superabsorbent particles may be arranged in a non-step-wise gradient through a substantial portion of the thickness (z-direction) of the absorbent structure, with lower concentrations toward the bodyside of the absorbent body and relatively higher concentrations toward the outerside of the absorbent structure. Suitable z-gradient configurations are described in U.S.P. 4,699,823 issued October 13, 1987 to Kellenberger et al., the entire disclosure of which is incorporated herein by reference in a manner that is consistent (not in conflict) with the present description. Alternatively, the concentrations of superabsorbent particles may be arranged in a non-step-wise gradient, through a substantial portion of the thickness (z-direction) of the absorbent structure, with higher concentrations toward the bodyside of the absorbent body and relatively lower concentrations toward the outerside of the absorbent structure. The superabsorbent particles may also be arranged in a generally discrete layer within the matrix of hydrophilic fibers. In addition, two or more different types of superabsorbent may be selectively positioned at different locations within or along the fiber matrix.

The high-absorbency material may comprise absorbent gelling materials, such as superabsorbents. Absorbent gelling materials can be natural, synthetic and modified natural polymers and materials. In addition, the absorbent gelling materials can be inorganic materials, such as silica gels, or organic compounds such as cross-linked polymers. The term "cross-linked" refers to any means for effectively rendering normally water-soluble materials substantially water insoluble but swellable. Such means can include, for example, physical entanglement, crystalline domains, covalent bonds, ionic complexes and associations, hydrophilic associations, such as hydrogen bonding, and hydrophobic associations or Van der Waals forces.

Examples of synthetic absorbent gelling material polymers include the alkali metal and ammonium salts of poly(acrylic acid) and poly (methacrylic acid), poly(acrylamides), poly(vinyl ethers), maleic anhydride copolymers with vinyl ethers and alpha-olefins, poly(vinyl pyrrolidone), poly(vinylmorpholinone), poly(vinyl alcohol), and mixtures and copolymers thereof. Further polymers suitable for use in the absorbent body include natural and modified natural polymers, such as hydrolyzed acrylonitrile-grafted starch, acrylic acid grafted starch, methyl cellulose, chitosan, carboxymethyl cellulose, hydroxypropyl cellulose, and the natural gums, such as alginates, xanthan gum, locust

bean gum and the like. Mixtures of natural and wholly or partially synthetic absorbent polymers can also be useful in the present invention. Other suitable absorbent gelling materials are disclosed by Assarsson et al. in U.S. Patent No. 3,901,236 issued August 26, 1975. Processes for preparing synthetic absorbent gelling polymers are disclosed in U.S. Patent No. 4,076,663 issued February 28, 1978 to Masuda et al. and U.S. Patent No. 4,286,082 issued August 25, 1981 to Tsubakimoto et al.

Synthetic absorbent gelling materials typically are xerogels which form hydrogels when wetted. The term "hydrogel", however, has commonly been used to also refer to both the wetted and unwetted forms of the material.

As mentioned previously, the high-absorbency material used in absorbent body 32 is generally in the form of discrete particles. The particles can be of any desired shape, for example, spiral or semi-spiral, cubic, rod-like, polyhedral, etc. Shapes having a large greatest dimension/smallest dimension ratio, like needles, flakes, and fibers, are also contemplated for use herein. Conglomerates of particles of absorbent gelling material may also be used in absorbent body 32. Desired for use are particles having an average size of from about 20 microns to about 1 millimeter. "Particle size" as used herein means the weighted average of the smallest dimension of the individual particles.

The hydrophilic fibers and high-absorbency particles can be configured to form an average composite basis weight which is within the range of about 400 - 900 gsm. In certain aspects of the invention, the average composite basis weight is within the range of about 500 - 800 gsm, and alternatively is within the range of about 550 - 750 gsm to provide desired performance.

To improve the containment of the high-absorbency material, absorbent body structure 32 can include an overwrap, such as wrap sheet 74, which is placed immediately adjacent and around absorbent body 32 and may be bonded to the absorbent structure and to the various other components of the article. The wrap sheet is preferably a layer of absorbent material which covers the major bodyside and outerside surfaces of the absorbent body, and preferably encloses substantially all of the peripheral edges of the absorbent body to form a substantially complete envelope thereabout. Alternatively, the wrap sheet can provide an absorbent wrapping which covers the major bodyside and outerside surfaces of the absorbent body, and encloses substantially only the lateral side edges of the absorbent body. Accordingly, both the linear and the inwardly curved portions of the

lateral side edges of the wrap sheet would be closed about the absorbent body. In such an arrangement, however, the end edges of the wrap sheet may not be completely closed around the end edges of the absorbent body at the waistband regions of the article.

For example, the complete wrap sheet 74, or at least the bodyside layer of the wrap sheet, may comprise a meltblown web composed of meltblown fibers, such as meltblown polypropylene fibers. Another example of absorbent wrap 74 may comprise a low porosity cellulosic web, such as a tissue composed of an approximately 50/50 blend of hardwood/softwood fibers.

The absorbent wrap 74 may comprise a multi-element wrapsheet which includes a separate bodyside wrap layer and a separate outerside wrap layer, each of which extends past all or some of the peripheral edges of absorbent body 32. Such a configuration of the wrap sheet can, for example, facilitate the formation of a substantially complete sealing and closure around the peripheral edges of absorbent body 32. In the back waistband portion of the illustrated diaper, the absorbent wrap may also be configured to extend an increased distance away from the periphery of the absorbent body to add opacity and strength to the back side-sections of the diaper. In the illustrated embodiment, the bodyside and outerside layers of absorbent wrap 74 can extend at least about 1/2 inch beyond the peripheral edges of the absorbent body to provide an outwardly protruding, flange-type bonding area over which the periphery of the bodyside portion of the absorbent wrap may be completely or partially connected to the periphery of the outerside portion of the absorbent wrap.

The bodyside and outerside layers of wrap sheet 74 may be composed of substantially the same material, or may be composed of different materials. For example, the outerside layer of the wrap sheet may be composed of a relatively lower basis weight material having a relatively high porosity, such as a wet strength cellulosic tissue composed of softwood pulp. The bodyside layer of the wrap sheet may comprise one of the previously described wrap sheet materials which has a relatively low porosity. The low porosity bodyside layer can better prevent the migration of superabsorbent particles onto the wearer's skin, and the high porosity, lower basis weight outerside layer can help reduce costs.

Diaper 10 can also include a surge management layer 46 which helps to decelerate and diffuse surges or gushes of liquid that may be rapidly introduced into the absorbent body

of the article. Desirably, the surge management layer can rapidly accept and temporarily hold the liquid prior to releasing the liquid into the storage or retention portions of the absorbent structure. In the illustrated embodiment, for example, surge layer 46 can be located on an inwardly facing body side surface of topsheet layer 28. Alternatively, surge layer 46 may be located adjacent to an outer side surface of topsheet 28. Accordingly, the surge layer would then be interposed between topsheet 28 and absorbent body 32. Examples of suitable surge management layers 46 are described in U.S. Patent Application Serial No. 206,986 of C. Ellis and D. Bishop, entitled FIBROUS NONWOVEN WEB SURGE LAYER FOR PERSONAL CARE ABSORBENT ARTICLES AND THE LIKE, filed March 4, 1994 (attorney docket No. 11,256) which corresponds to U.S. Patent No. 5,486,166; and U.S. Patent Application Serial No. 206,069 of C. Ellis and R. Everett, entitled IMPROVED SURGE MANAGEMENT FIBROUS NONWOVEN WEB FOR PERSONAL CARE ABSORBENT ARTICLES AND THE LIKE, filed March 4, 1994 (attorney docket No. 11,387) which corresponds to U.S. Patent No. 5,490,846; the entire disclosures of which are hereby incorporated by reference in a manner that is consistent herewith.

The leg elastic members 34 are located in the lateral side margins 20 of diaper 10, and are arranged to draw and hold diaper 10 against the legs of the wearer. The elastic members are secured to diaper 10 in an elastically contractible condition so that in a normal under strain configuration, the elastic members effectively contract against diaper 10. The elastic members can be secured in an elastically contractible condition in at least two ways, for example, the elastic members may be stretched and secured while diaper 10 is in an uncontracted condition. Alternatively, diaper 10 may be contracted, for example, by pleating, and the elastic members secured and connected to diaper 10 while the elastic members are in their relaxed or unstretched condition. Still other mechanisms, such as heat-shrink elastic material, may be used to gather the garment.

In the embodiment illustrated in Figs. 1 and 2, the leg elastic members 34 extend essentially along the complete length of the intermediate crotch region 16 of diaper 10. Alternatively, elastic members 34 may extend the entire length of diaper 10, or any other length suitable for providing the arrangement of elastically contractible lines desired for the particular diaper design.

The elastic members 34 may have any of a multitude of configurations. For example, the width of the individual elastic members 34 may be varied from about 0.25 millimeters

(0.01 inch) to about 25 millimeters (1.0 inch) or more. The elastic members may comprise a single strand of elastic material, or may comprise several parallel or non-parallel strands of elastic material, or may be applied in a rectilinear or curvilinear arrangement. Where the strands are non-parallel, two or more of the strands may intersect or otherwise interconnect within the elastic member. The elastic members may be affixed to the diaper in any of several ways which are known in the art. For example, the elastic members may be ultrasonically bonded, heat and pressure sealed using a variety of bonding patterns, or adhesively bonded to diaper 10 with sprayed or swirled patterns of hotmelt adhesive.

In particular embodiments of the invention, the leg elastic members 34 may include a carrier sheet to which are attached a grouped set of elastics composed of a plurality of individual elastic strands. The elastic strands may intersect or be interconnected, or be entirely separated from each other. The carrier sheet may, for example, comprise a 0.002 cm thick polymer film, such as a film of unembossed polypropylene material. The elastic strands can, for example, be composed of LYCRA elastomer available from DuPont, a business having offices in Wilmington, Delaware. Each elastic strand is typically within the range of about 470 - 1500 decitex (dtx), and may be about 940 - 1050 dtx. In particular embodiments of the invention, for example, three or four strands can be employed for each elasticized legband.

In addition, the leg elastics 34 may be generally straight or optionally curved. For example, the curved elastics can be inwardly bowed toward the longitudinal centerline of the diaper. In particular arrangements, the curvature of the elastics may not be configured or positioned symmetrically relative to the lateral centerline of the diaper. The curved elastics may have an inwardly bowed and outwardly bowed, reflex-type of curvature, and the length-wise center of the elastics may optionally be offset by a selected distance toward either the front or rear waistband of the diaper to provide desired fit and appearance. In particular embodiments of the invention, the innermost point (apex) of the set of curved elastics can be offset towards the front or rear waistband of the diaper, and the outwardly bowed reflexed-portion can be positioned toward the diaper front waistband.

As representatively shown, the diaper 10 can include a waist elastic 42 positioned in the longitudinal margins of either or both of the front waistband 14 and the rear waistband 12. The waist elastics may be composed of any suitable elastomeric material, such as an elastomer film, an elastic foam, multiple elastic strands, an elastomeric fabric or the like. For example, suitable elastic waist constructions are described in U.S. Patent

No. 4,916,005 to Lippert et al., the entire disclosure of which is hereby incorporated by reference in a manner that is consistent herewith.

With reference to the representative configurations shown in Figs. 1 and 2, the article can include a system of "ear" regions or ear members 38. In particular arrangements, each ear region or member 38 extends laterally at the opposed, lateral ends of at least one waistband portion of backsheet 30, such as the representatively shown rear waistband portion 12, to provide terminal side sections of the article. In addition, each ear region can substantially span from a laterally extending, terminal waistband edge to approximately the location of its associated and corresponding leg opening section of the diaper. The diaper 10, for example, has a laterally opposed pair of leg openings provided by the curved margins of the ear regions in combination with the correspondingly adjacent, medial sections of the shown pair of longitudinally extending, side edge regions 20 (Fig. 1).

In the various configurations of the invention, the ear regions may be integrally formed with a selected diaper component. For example, ear regions 38 can be integrally formed from the layer of material which provides backsheet layer 30, or may be integrally formed from the material employed to provide topsheet 28. In alternative configurations, the ear regions 38 may be provided by one or more separately provided members that are connected and assembled to the backsheet 30, to the topsheet 28, in between the backsheet and topsheet, or in various fixedly attached combinations of such assemblies.

In particular configurations of the invention, each of the ear regions 38 may be formed from a separately provided piece of material which is then suitably assembled and attached to the selected front and/or rear waistband portion of the diaper article. For example, each ear region 38 may be attached to the rear waistband portion of the backsheet 30 along a ear region attachment zone, and can be operably attached to either or both of the backsheet and topsheet components of the article. The inboard, attachment zone region of each ear region can be overlapped and laminated with its corresponding, lateral end edge region of the waistband section of the article. The ear regions extend laterally to form a pair of opposed waist-flap sections of the diaper, and are attached with suitable connecting means, such as adhesive bonding, thermal bonding, ultrasonic bonding, clips, staples, sewing or the like. Desirably, the ear regions extend laterally beyond the terminal side edges of the backsheet layer and topsheet layer at the corresponding, attached waistband section of the article.

The ear regions 38 may be composed of a substantially non-elastomeric material, such as polymer films, woven fabrics, nonwoven fabrics or the like, as well as combinations thereof. In particular aspects of the invention, ear regions 38 may be composed of a substantially elastomeric material, such as a stretch-bonded-laminate (SBL) material, a neck-bonded-laminate (NBL) material, an elastomeric film, an elastomeric foam material, or the like, which is elastomerically stretchable at least along the lateral direction 24. For example, suitable meltblown elastomeric fibrous webs for forming ear regions 38 are described in U.S.P. 4,663,220 issued May 5, 1987 to T. Wisneski et al., the entire disclosure of which is hereby incorporated by reference. Examples of composite fabrics comprising at least one layer of nonwoven textile fabric secured to a fibrous elastic layer are described in European Patent Application EP 0 217 032 A2 published on April 8, 1987 which has the listed inventors of J. Taylor et al., the entire disclosure of which is hereby incorporated by reference. Examples of NBL materials are described in U.S. Patent No. 5,226,992 issued July 13, 1993 to Mormon, the entire disclosure of which is hereby incorporated by reference in a manner that is consistent herewith.

As previously mentioned, various suitable constructions can be employed to attach the ear regions 38 to the selected waistband portions of the article. Particular examples of suitable constructions for securing a pair of elastically stretchable members to the lateral, side portions of an article to extend laterally outward beyond the laterally opposed side regions of the outer cover and liner components of an article can be found in U.S. Patent No. 4,938,753 issued July 3, 1990 to P. VanGompel et al., the entire disclosure of which is hereby incorporated by reference in a manner that is consistent herewith.

Each of the ear regions 38 extends laterally at a one of the opposed lateral ends of at least one waistband section of the diaper 10. In the shown embodiment, for example, a first pair of ear regions extend laterally at the opposed lateral ends of the back waistband section of the backsheet 30. Additionally, a second pair of ear regions may be included to extend laterally at the opposed lateral ends of the front waistband section of the backsheet. The illustrated ear regions have a tapered, curved or otherwise contoured shape in which the longitudinal length of the relatively inboard base region is larger or smaller than the longitudinal length of its relatively outboard end region. Alternatively, the ear regions may have a substantially rectangular shape, and optionally may have a substantially trapezoidal shape.

Diaper 10 can also include a pair of elasticized containment flaps 62 which extend generally length-wise along the longitudinal direction 26 of the diaper. The containment flaps are typically positioned laterally inboard from leg elastics 34, and substantially symmetrically placed on each side of the lengthwise, longitudinal centerline of the diaper. In the illustrated arrangements, each containment flap 62 has a substantially fixed edge portion 64 and a substantially moveable edge portion 66, and is operably elasticized to help each containment flap to closely contact and conform to the contours of the wearer's body. Examples of suitable containment flap constructions are described in U.S. Patent No. 4,704,116 issued November 3, 1987, to K. Enloe, the entire disclosure of which is hereby incorporated by reference in a manner that is consistent herewith. The containment flaps may be composed of a wettable or a non-wettable material, as desired. In addition, the containment flap material may be substantially liquid-impermeable, may be permeable to only gas or may be permeable to both gas and liquid. Other suitable containment flap configurations are described in U.S. Patent Application Serial No. 206,816 of R. Everett et al., filed March 4, 1994 and entitled ABSORBENT ARTICLE HAVING AN IMPROVED SURGE MANAGEMENT (attorney docket No. 11,375), which corresponds to U.S. Patent 5,562,650, the disclosure of which is hereby incorporated by reference in a manner that is consistent herewith.

In optional, alternative configurations of the invention, diaper 10 may include internal, elasticized, containment waist flaps, such as those described in U.S. Patent No. 4,753,646 issued June 28, 1988, to K. Enloe, and in U.S. Patent Application Serial No. 560,525 of D. Laux et al. entitled AN ABSORBENT ARTICLE WITH IMPROVED ELASTIC MARGINS AND CONTAINMENT SYSTEM and filed December 18, 1995 (attorney docket No. 11,091), the entire disclosures of which are hereby incorporated by reference in a manner that is consistent herewith. Similar to the construction of the containment flaps, the containment waist flaps may be composed of a wettable or non-wettable material, as desired. The waist flap material may be substantially liquid-impermeable, permeable to only gas, or permeable to both gas and liquid.

To provide a desired refastenable fastening system, diaper 10 can include one or more, appointed landing member regions or patches, such as provided by the representatively shown, primary landing member 50. The landing member can provide an operable target area for generating a releasable and re-attachable securement with at least one of the fastener tabs 36. In desired embodiments of the invention, the landing member patch can be positioned on the front waistband portion 14 of the diaper and located on the outward

surface of the backsheet layer 30. Alternatively, the landing member patch can be positioned on an appointed inward surface of the diaper, such as the bodyside surface of the topsheet layer 28.

Particular arrangements of the invention can include one or more landing members 50 which can be directly or indirectly attached to the second waistband portion 14. Desirably, the landing members are affixed directly to the outward surface of the appropriate waistband portion, but may optionally be joined to the inward, bodyside surface of the article waistband portion.

In the various configurations of the invention, the landing member 50 can be composed of a substantially non-elastomeric material, such as polymer films or tapes, woven fabrics, nonwoven fabrics or the like, as well as combinations thereof. In particular configurations of the invention, the landing member may be composed of a substantially elastomeric material, such as a stretch-bonded-laminate (SBL) material, a neck-bonded-laminate (NBL) material, an elastomeric film, an elastomeric foam material, or the like, which is elastomerically stretchable at least along the lateral direction 24.

The various configurations of the invention can include at least one separately provided fastener tab 36 located at either or both of the lateral end regions 86 of the back waistband 12. Alternatively, the at least one separately provided fastener tab 36 can be located at either or both of the lateral end regions 88 of the front waistband 14. The representatively shown embodiment, for example, has a laterally opposed pair of the fastener tabs 36 with a one of the fastener tabs located at each of the distal side edges of the rear waistband 12. More particularly, each of the fasteners 36 is assembled and attached to project and extend from a corresponding, immediately adjacent ear region located at one of the opposed, lateral end regions 86 of the front waistband section 12.

The fastener tab 36 can be composed of a substantially non-elastomeric material, such as polymer films or tapes, woven fabrics, nonwoven fabrics or the like, as well as combinations thereof. Optionally, the fastener tab may be composed of a substantially elastomeric material, such as a stretch-bonded-laminate (SBL) material, a neck-bonded-laminate (NBL) material, an elastomeric film, an elastomeric foam material, or the like, which is elastomerically stretchable at least along the lateral direction 24.

In the various aspects and configurations of the invention, the fastening mechanism between the selected first fastener component and the selected, second fastener component may be adhesive, cohesive, mechanical or combinations thereof. In the context of the present invention, a mechanical fastening system is a system which includes cooperating, first and second components which mechanically inter-engage to provide a desired securement.

Desirably, the first and second fastener components include complementary elements of a cooperatively interengaging mechanical fastening system. The mechanical fastener components can be provided by mechanical-type fasteners such as hooks, buckles, snaps, buttons and the like, which include cooperating and complementary, mechanically interlocking components.

As shown in the illustrated arrangements, for example, the mechanical fastening system may be a hook-and-loop type of fastening system. Such fastening systems typically include engagement members having the form of a "hook" or hook-like, male component, and include a cooperating "loop" or loop-like, female component which engages and releasably interconnects with the hook component. Desirably, the interconnection is selectively releasable and re-attachable. Conventional systems are, for example, available under the VELCRO trademark. The hook element may be provided by a single-prong hook configuration, a multiple-prong hook configuration or by a generally continuous, expanded-head configuration, such as provided by a mushroom-head type of hook element. The loop element may be provided by a woven fabric, a nonwoven fabric, a knitted fabric, a perforated or apertured layer, and the like, as well as combinations thereof. The many arrangements and variations of such fastener systems have been collectively referred to as hook-and-loop fasteners.

A configuration which employs a selectively releasable, interengaging mechanical fastening system can, for example, locate the first fastener component on at least the appointed mating or securing surface of the fastener tab 36, and can locate the cooperating, second fastener component on the appointed engagement surface of the appointed landing member 50. For example, with the representatively shown hook-and-loop fastener, the fastening component which is attached to the appointed mating or securing surface of the fastener tab 36 may include a hook type of mechanical engagement element, and the complementary fastening component, which is operably

joined and attached to the appointed landing zone member 50 can include a loop type of fastening element.

It should also be readily apparent that, in the various configurations of the invention, the relative positions and/or materials of the first fastening component and its cooperating, complementary second fastening component can be transposed. Accordingly, the fastening component, which is attached to the appointed mating surface of the fastener tabs 36, may include the loop type of mechanical fastening element; and the complementary, second fastening component, which is operatively joined and attached to the appointed landing zone member, can include the hook type of engagement members.

Examples of hook-and-loop fastening systems and components are described in U.S.P. 5,019,073 issued May 28, 1991 to T. Roessler et al., the entire disclosure of which is hereby incorporated by reference in a manner that is consistent herewith. Other examples of hook-and-loop fastening systems are described in U.S. Patent Application Serial No. 366,080 entitled HIGH-PEEL TAB FASTENER, filed December 28, 1994 by G. Zehner et al. (attorney docket No. 11,571) which corresponds to U.S. Patent No. 5,605,735; and U.S. Patent Application Serial No. 421,640 entitled MULTI-ATTACHMENT FASTENING SYSTEM, filed April 13, 1995 by P. VanGompel et al.; the entire disclosures of which are hereby incorporated by reference in a manner that is consistent herewith. Examples of fastening tabs constructed with a carrier layer are described in U.S. Patent Application Serial No. 08/603,477 of A. Long et al., entitled MECHANICAL FASTENING SYSTEM WITH GRIP TAB and filed March 6, 1996 (attorney docket No. 12,563) which corresponds to U.S. Patent No. 5,624,429 which issued April 29, 1997, the entire disclosure of which is hereby incorporated by reference in a manner which is consistent herewith.

With reference to Figs. 5 and 6, the appointed first fastener component 70 can include a material having engagement members (e.g. the shown hook members) which project away from a base or substrate layer 110. Each engagement member includes a generally, up-standing stem portion 58 and a securement element 60. The stem portion 58 has a fixed end region 43, and a distal end region 44 which, desirably, is contiguously joined with the fixed end region. The fixed end region of the stem portion is operably attached to the substrate layer 110, and the distal end region is operably attached to its corresponding, associated securement element 60. The stem portion 58 is sufficiently rigid to maintain the appointed upright positioning and the appointed directional

alignment of the securement element 60 during the ordinary operation of the first fastener component in the fastener system. More particularly, the stem portion is sufficiently resistant to bending and twisting to operably maintain the desired upright positioning and directional alignment of the securement element. The substrate layer 110 has a substrate thickness 112, an engagement member surface 114, and an opposed substrate mounting surface 116. The selected engagement members are attached to the substrate layer 110, and project away from the engagement member surface 114.

As illustrated with respect to the non-symmetric engagement member representatively shown in Fig. 9, the engagement member can have a substantially axial dimension 90 and a substantially circumferential dimension 92. The axial dimension extends along the projecting length of the engagement member, and follows the bends and curves that may be present in the engagement member. The circumferential dimension extends around the engagement member in a belt-like manner, and follows the outer surface of the engagement member. At each particular local position along the projecting length of the engagement member, the circumferential dimension can define a plane which is oriented substantially perpendicular to the local axial dimension of the engagement member. The securement element portion 60 has an appointed base portion which is affixed to the distal end region of its stem portion 58, and has at least one, substantially free securement end 77 which cooperates with its corresponding stem portion to provide at least one individual engagement opening 78. Optionally, the securement element portion can be configured to provide a predetermined plurality of engagement openings (e.g. Fig. 4).

As representatively shown in Figs. 4 through 5, particular aspects of the invention may incorporate non-isotropic engagement members where the non-isotropic engagement members are configured to provide a directional or direction-dependent engagement with the cooperating second fastener component 72. Accordingly, with regard to a selected engagement parameter, the non-isotropic engagement member can provide a combination of two or more different fastening engagement values, with the value depending upon the direction along which the selected engagement parameter is measured. Thus, the non-isotropic (anisotropic) property of a fastener component pertains to the difference in one or more fastening properties that can be exhibited when the fastening component and associated engagement members are tensioned or otherwise stressed along different directions which are aligned substantially parallel to or generally along the extending area, "x-y" plane, of the fastening component. In particular,

the engagement members can exhibit at least one bias direction along which a selected fastening property, such as peel force, shear force or the like, has a relatively different value. For example, the fastening property may have at least one bias direction along which a fastening property, such as peel force, shear force or the like, has a relatively maximal value. Similarly, the engagement members can exhibit at least one bias direction along which the selected fastening property has a relatively minimal value. The direction of maximal value may or may not be substantially opposite to the direction of relatively minimal value.

Thus, the non-isotropic engagement member may provide a greater (or lesser) shear force value or peel force value depending upon the direction along which the shear force or peel force value is determined. The non-isotropic feature may be generated by various suitable mechanisms, such as a difference in shape, size dimension, contour, length of projection, angle of projection, type of material, type of coating or other treatment, surface texture, surface topography, coefficient of friction, cohesion or the like, as well combinations thereof. The non-isotropic engagement member may have a limited degree of symmetry, such as a bilateral symmetry. Suitable non-isotropic engagement members can, for example, be provided by inverted-J shaped or generally T-shaped engagement members. In contrast, substantially isotropic engagement members may be provided by mushroom shaped engagement members where the mushroom head is substantially symmetrically distributed about its upstanding stem portion and where the appointed engagement opening is similarly substantially symmetrically distributed about its upstanding stem portion.

Examples of other non-isotropic engagement members are representatively shown in Figs. 5 through 7A. Figs. 5 and 5A illustrate an engagement member 56 which includes a stem portion 58 having a generally circular-shaped cross-section, and a securement element 60 having a generally oval-shaped cross-section. Figs. 6 and 6A representatively show another version of an engagement member 56 which includes a stem portion 58 having a generally circular-shaped cross-section, and a securement element 60 having a generally oval-shaped cross-section. In Figs. 6 and 6A, the shown securement element 60 is constructed with a more pronounced "droop" in the hook shape at the free ends 77 of the oval-shaped securement element. Figs. 7 and 7A illustrate an engagement member which includes a securement element 60 configured with multiple prongs. The prongs extend in opposite directions, and are offset from each other in a side-by-side

arrangement. In the shown arrangement, the prongs are both joined to appointed, interconnected portions of a common stem portion.

In another aspect, the first fastener component may include non-symmetric engagement members, as representatively shown in Figs. 8 and 8A. The non-symmetric engagement members have securement elements which are asymmetrically disposed with respect to a primary axis 79. The primary axis extends linearly generally along the stem portion of the engagement member towards the substrate layer 110, and intersects the substrate layer at a substantially perpendicular angle. As one moves circumferentially about the primary axis 79, the securement element 60 is observed to be non-symmetrically disposed about the primary axis. In particular, there can be a reference plane which is oriented substantially along the stem portion of the engagement member to include the primary axis 79. Accordingly, the reference plane can be generally perpendicular to the base substrate of the engagement members. When the reference plane is rotated about the primary axis, there is essentially no circumferentially rotated position (angle of rotation) at which one observes a bilateral symmetry of the securement element within the reference plane. Accordingly, when viewing the portion of the securement element which lies within the reference plane at each angle of rotation or the reference plane, there is substantially no rotational angle at which there is a symmetry of the securement element with respect to opposite sides of the line of the primary axis.

The non-symmetric engagement members are configured to provide a direction-dependent and non-symmetrical engagement with the cooperating second fastener component 72. Accordingly, with regard to a selected engagement parameter, the non-symmetric engagement member can provide a non-isotropic combination of two or more different fastening engagement values depending upon the path along which the selected engagement parameter is measured. Additionally, with regard to opposed directions along the selected path, the fastening engagement values of the selected engagement parameter are non-symmetric and unequal in magnitude. Thus, the non-symmetric property of a fastener component pertains to the difference in one or more fastening properties that can be exhibited when the fastening component and associated engagement members are tensioned or otherwise stressed along different paths which are aligned generally along the extending area, "x-y" plane, of the fastening component. In particular, the engagement members can exhibit at least one path along which a selected fastening property, such as peel force, shear force or the like, has a non-symmetric magnitude when determined with respect opposite directions along the path.

The asymmetry may be generated by various suitable mechanisms, such as a difference in shape, size dimension, contour, length of projection, type of material, type of coating or other treatment, surface texture, surface topography, coefficient of friction, cohesion or the like, as well combinations thereof. For example, inverted J-shaped engagement members typically have non-symmetrically disposed securement elements, and typically provide non-symmetrically disposed engagement openings. Other examples of non-symmetrical engagement members are representatively shown in Figs. 10 and 10A. In contrast, T-shaped engagement members and mushroom-head shaped engagement members can typically have symmetrically disposed securement elements, and can typically provide symmetrically disposed and symmetrically sized engagement openings.

In the various configurations of the invention, the first engagement section 52 has a first plurality of engagement members 56, and the second engagement section 54 has a second plurality of engagement members 56. In particular aspects of the invention, each of the first and second engagement sections 52 and 54 can be formed or otherwise provided on substantially a single, unitary piece of the substrate layer 110. Thus, the appointed region of the substrate layer employed for the first engagement section 52 can be substantially contiguous with the appointed region of the substrate layer employed for the second engagement section 54. Alternatively, the first and second engagement sections 52 and 54 can be formed or otherwise provided on individual, separately provided sections or pieces of the substrate layer material.

With reference to Fig. 1 and Figs. 11 through 11E, the first fastener component can include a first engagement section 52 having a first plurality of non-isotropic engagement members, and a second engagement section 54 having a second plurality of non-isotropic engagement members. As illustrated in Figs. 11 through 11C, the first fastener component can include a first engagement section 52 having a first plurality of non-isotropic and non-symmetric engagement members, and the second engagement section 54 having a second plurality of non-isotropic and non-symmetric engagement members. As illustrated in Figs. 11D and 11E, the first fastener component can include a first engagement section 52 having a first plurality of non-isotropic and symmetric engagement members, and the second engagement section 54 having a second plurality of non-isotropic and symmetric engagement members. Optionally, the non-isotropic engagement members in the first engagement section 52 and/or the second engagement section 54 may be provided by a combination of symmetric and non-symmetric

engagement members which are non-isotropic. Each non-isotropic engagement member can have a stem portion 58 with a distal end region 44, and can have a corresponding non-isotropic (symmetric or non-symmetric) securement element, respectively, disposed at the distal end region of its corresponding stem portion 58 to provide a corresponding non-isotropic (symmetric or non-symmetric) engagement opening.

As representatively shown, a majority of the first plurality of non-isotropic engagement members can have a primary portion of their non-isotropic engagement openings 78 directed substantially along a first vector which has a first, primary cross-directional vector-component directed along the lateral direction 24. For example, the engagement openings may be aligned substantially along the lateral direction 24 and may be directed toward and/or away from the medial line 40 of the article. A majority of the second plurality of non-isotropic engagement members have the primary portion of their corresponding non-isotropic engagement openings directed substantially along a second vector which is directed away from the first cross-directional vector-component. Desirably, the second vector is directed away from the first cross-directional vector-component by an offset angle 80 which is at least about ± 45 degrees, as representatively shown in Fig. 12. Alternatively, the second vector is directed away by an angular offset difference of at least about ± 60 degrees, and optionally, is directed away by an angular offset difference of at least about ± 85 degrees to provide improved performance. In other aspects, the second vector can be directed away from the first cross-directional vector-component with an offset angle 80 which is not more than about 90 degrees. In a desired arrangement, such as representatively shown in Figs. 11 and 11D, the second vector may be aligned substantially along the longitudinal direction 26 of the article. Accordingly, the majority of the second plurality of non-isotropic or non-symmetric engagement members have their engagement openings directed substantially along the longitudinal direction 26.

In particular aspects, at least a minimum of about 60 % of the first plurality of non-isotropic (symmetric or non-symmetric) engagement members can be oriented with their primary engagement openings directed along the first vector. Accordingly, at least about 60% of the first plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed substantially along the lateral direction 24. Accordingly, at least about 60% of the engagement openings may be directed toward and/or away from the medial line 40 of the article. Alternatively, at least about 70%, and optionally, at least about 80% of the first plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed along the first vector to

provide improved performance. A desired arrangement can have approximately 100% of the first plurality of non-isotropic engagement members oriented with their engagement openings directed along the first vector. For example, approximately 100% of the first plurality of non-isotropic engagement members may be oriented with their engagement openings aligned along the lateral direction 24 and directed relatively inboard and/or outboard of the article.

In still other aspects, at least about 60% of the second plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed along the second vector. In particular arrangements, at least about 60% of the second plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed along the appointed second vector. Alternatively, at least about 70%, and optionally, at least about 80% of the second plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed along the second vector to further provide improved benefits. For example, approximately 100% of the second plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed along the second vector. A desired arrangement can have at least about 60% of the second plurality of non-isotropic engagement members oriented with their primary engagement openings directed along the longitudinal direction 26 of the article. Alternatively, at least about 80%, and optionally, approximately 100% of the second plurality of non-isotropic engagement members can be oriented with their primary engagement openings directed along the longitudinal direction 26.

With reference to Figs. 13 and 13A, the first fastener component 70 can include a first engagement section 52 having a first plurality of non-symmetric engagement members 56, and a second engagement section 54 having a second plurality of non-symmetric engagement members. Each non-symmetric engagement member 56 has a stem portion 58 and a securement element 60. In the representatively shown configuration, the stem portion 58 of each engagement member 56 has a fixed end 43 which is operatively attached to a substrate or base of the first fastener component 70, and has a substantially free, distal end region 44, which is arranged opposite to and substantially contiguously connected with its correspondingly associated fixed end. The securement element 60 is asymmetrically disposed at a distal end region of its corresponding stem portion 58 to provide a primary, asymmetric engagement opening. A majority of the first plurality of non-symmetric engagement members may have an

appointed asymmetric portion of their non-symmetric engagement openings directed substantially along a first vector which has a first cross-directional vector-component directed along the lateral direction 24 of the article and toward the medial line 40. Thus, the first vector-component can be aligned substantially perpendicular to the medial line 40, and substantially perpendicular to the longitudinal direction 26 of the article. A majority of the second plurality of non-symmetric engagement members have the appointed primary portion of their non-symmetric engagement openings directed substantially along a second vector which is directed away from the first cross-directional vector-component. Desirably, the second vector which is directed away from the first cross-directional vector-component with an offset angle of at least ± 45 degrees. Alternatively, the second vector can be directed away from the first cross-directional vector-component with an angular offset difference of at least about ± 60 degrees, and optionally, the second vector can be directed away from the first cross-directional vector-component with an angular offset difference of at least about ± 85 degrees to provide improved performance. In other aspects, the second vector can be directed away from the first cross-directional vector-component with an angular offset difference of up to about ± 135 degrees, and optionally, up to about ± 180 degrees to provide further benefits.

Thus, the second vector may have a second cross-directional vector-component directed substantially along the lateral direction 24 and away from the medial line 40 of the article. Accordingly, the majority of the second plurality of non-symmetric engagement members can have their primary, non-symmetric engagement openings directed substantially away from the alignment direction of the engagement openings of the first plurality of engagement members. In a desired arrangement, the first vector is entirely directed inboard along the lateral direction 24 toward the article medial line 40, and the second vector is entirely directed outboard along the lateral direction 24 away from the article medial line. Accordingly, the majority of the first plurality of non-symmetric engagement members can have their primary non-symmetric engagement openings aligned with and directed substantially parallel to the lateral direction 24 facing toward the article medial line 40, and the majority of the second plurality of non-symmetric engagement members can have their non-symmetric engagement openings aligned with and directed substantially parallel to the lateral direction 24 facing away from the article medial line.

In particular aspects, at least a minimum of about 60 % of the first plurality of non-symmetric engagement members can be oriented with their primary engagement

openings directed along the first vector. For example, at least about 60% of the first plurality of non-symmetric engagement members can be oriented with their primary engagement openings directed relatively inboard of the article and substantially toward the article medial line 40. Alternatively, at least about 70%, and optionally, at least about 80% of the first plurality of non-symmetric engagement members can be oriented with their primary engagement openings directed along the first vector to provide improved performance. In still other aspects, at least about 60% of the second plurality of non-symmetric engagement members can be oriented with their primary engagement openings directed along the second vector. For example, at least about 60% of the second plurality of non-symmetric engagement members can be oriented with their primary engagement openings directed relatively outboard of the article and substantially away from the article medial line 40. Alternatively, at least about 70%, and optionally, at least about 80% of the second plurality of non-symmetric engagement members can be oriented with their primary engagement openings directed along the second vector to further provide improved benefits.

In the various aspects of the invention, the distribution and presence of the engagement members in the second engagement section 54 can extend to the laterally outboard, terminal edge of its corresponding fastener tab 36. Accordingly, the presence of the operative engagement members can extend in the longitudinal direction 26, substantially continuously along a major portion of the length-wise dimension of the outboard terminal edge of the fastener tab. Particular arrangements can have the engagement members extending substantially continuously along at least about 60% of the length-wise dimension of the outboard terminal edge of the fastener tab, and alternatively, can have the engagement members extending substantially continuously along at least about 70% of the length-wise dimension of the outboard terminal edge. Desirably, the presence of the operative engagement members can extend substantially continuously along approximately the entire length-wise dimension of the outboard terminal edge. In optional configurations, a substantially non-engaging lift tab may be provided along a portion of the length-wise dimension of the outboard terminal edge of the fastener tab. The lift tab may be integrally formed from the appointed fastening component or fastener tab substrate, or may be a separately provided member which is assembled and affixed along the outboard terminal edge of the fastener tab.

The various arrangements of the invention can include a fastener transition region 76 located between selected engagement sections. A majority of the first plurality of non-

symmetric engagement members have their asymmetric engagement openings directed substantially along a first vector which has a first selected alignment with the fastener transition region, and a majority of the second plurality of non-symmetric engagement members have their asymmetric engagement openings directed substantially along a second vector which has a different, second selected alignment with the fastener transition region. The transition region may be configured to extend along any operative direction. For example, the transition region 76 may be positioned between laterally adjacent regions of the first and second engagement sections 52 and 54, and as representatively shown, the transition region may be configured to extend substantially lengthwise along the longitudinal direction 26 of the article. The majority of the first plurality of non-symmetric engagement members can have their asymmetric engagement openings directed substantially along the first vector which has a cross-directional vector-component directed away from the fastener transition region 76. The majority of the second plurality of non-symmetric engagement members have their asymmetric engagement openings directed substantially along a second vector which has a second cross-directional vector-component directed away from the fastener transition region 76.

Particular, desired configurations of the invention may incorporate a first mechanical fastener component which includes a plurality of prong-type engagement members, such as the representatively shown J-shaped hooks, and a second mechanical fastener component which includes a plurality of loop elements. In addition, the first engagement section 52 of the first fastener component 70 can include a first plurality of non-symmetric, prong-type hook members, and the second engagement section 54 can include a second plurality of non-symmetric, prong-type hook members. Each non-symmetric hook member has a stem portion 58 with a distal end region 43, and a hook element can be asymmetrically disposed at the distal end region of its corresponding stem portion 58 to provide a primary non-symmetric hook opening. A majority of the first plurality of hook members can have their primary non-symmetric hook openings directed substantially along a first vector which has a cross-directional vector-component directed away from the fastener transition region 76. A majority of the second plurality of hook members can have their primary non-symmetric hook openings directed substantially along a second vector which has a cross-directional vector-component directed away from the fastener transition region 76.

Similarly, the first fastener component 70 can include a first plurality of non-isotropic, prong-type hook members, and the second engagement section 54 can include a second

plurality of non-isotropic hook members. Each non-isotropic hook member can have a hook element which is non-isotropically disposed at the distal end region of its corresponding stem portion 58 to provide a primary non-isotropic hook opening. A majority of the first plurality of hook members can have their primary hook openings directed substantially along a first vector which has a cross-directional vector-component directed along the lateral direction 24. For example, the majority of the first plurality of hook members can have their primary hook openings directed substantially toward and/or away from the fastener transition region 76. A majority of the second plurality of hook members can have their primary hook openings directed substantially along a second vector which is directed away from the first vector. For example, the majority of the second plurality of hook members can have their primary hook openings directed substantially along the longitudinal direction 26. In another example, the majority of the first plurality of hook members can have their primary hook openings directed substantially parallel to the fastener transition region 76, and the majority of the second plurality of hook members can have their primary hook openings directed substantially perpendicular to the fastener transition region. Optionally, the majority of the first plurality of hook members can have their primary hook openings directed substantially perpendicular to the fastener transition region 76, and the majority of the second plurality of hook members can have their primary hook openings directed substantially parallel to the fastener transition region.

In the various configurations with hook members, the hook members can be appropriately configured and aligned in accordance with directions of the first and second vectors which have been previously described in the context of the engagement members 56. In particular aspects, at least a minimum of about 60% of the first plurality of hook members can have their primary hook openings directed substantially along the first vector. Alternatively, at least about 70%, and optionally, at least about 80% of the first plurality of hook members can have their primary hook openings directed substantially along the first vector. In other aspects, at least about 60% of the second plurality of hook members can have their primary hook openings directed substantially along the second vector. Alternatively, at least about 70%, and optionally, at least about 80% of the second plurality of hook members can have their primary hook openings directed substantially along the second vector to provide improved benefits.

An example of a suitable micro-hook material is distributed under the designation VELCRO HTH 829, and is available from VELCRO U.S.A., Inc., a business having offices

in Manchester, New Hampshire. The micro-hook material can have hooks in the shape of angled hook elements, and can be configured with a hook density of about 264 hooks per square centimeter (about 1700 hooks per square inch); a hook height which is within the range of about 0.030 - 0.063 cm (about 0.012 - 0.025 inch); and a hook width which is within the range of about 0.007 to 0.022 cm (about 0.003 to 0.009 inch). The hook elements are molded onto a base layer substrate having a thickness of about 0.0076 - 0.008 cm (about 0.003 - 0.0035 inch), and the member of hook material has a Gurley stiffness of about 12 mgf (about 12 Gurley units). Other suitable hook materials can include VELCRO HTH 858, VELCRO HTH 851 and VELCRO HTH 863 hook materials.

For the purposes of the present invention, the various stiffness values are determined with respect to a bending moment produced by a force which is directed perpendicular to the plane substantially defined by the length and width of the component being tested. A suitable technique for determining the stiffness values described herein is a Gurley Stiffness test, a description of which is set forth in TAPPI Standard Test T 543 om-94 (Bending Resistance of Paper (Gurley type tester)). A suitable testing apparatus is a Gurley Digital Stiffness Tester; Model 4171-D manufactured by Teledyne Gurley, a business having offices in Troy, New York. For purposes of the present description, the stated Gurley stiffness values are intended to correspond to the values that would be generated by a "standard" sized sample. Accordingly, the scale readings from the Gurley stiffness tester are appropriately converted to the stiffness of a standard size sample, and are traditionally reported in terms of milligrams of force (mgf). Currently, a standard "Gurley unit" is equal to a stiffness value of 1 mgf, and may equivalently be employed to report the Gurley stiffness.

In the various aspects and configurations of the invention, the loop material can be provided by a nonwoven, woven or knit fabric. For example, a suitable loop material fabric can be composed of a 2 bar, warp knit fabric of the type available from Guilford Mills, Inc., Greensboro, North Carolina under the trade designation #34285, as well as other types of knit fabrics. Suitable loop materials are also available from the 3M Company, which has distributed a nylon woven loop under their SCOTCHMATE brand. The 3M Company has also distributed a linerless loop web with adhesive on the backside of the web, and 3M knitted loop tape.

The loop material may also include a nonwoven fabric having continuous bonded areas defining a plurality of discrete unbonded areas. The fibers or filaments within the discrete unbonded areas of the fabric are dimensionally stabilized by the continuous bonded areas that encircle or surround each unbonded area, such that no support or backing layer of film or adhesive is required. The unbonded areas are specifically designed to afford spaces between fibers or filaments within the unbonded area that remain sufficiently open or large to receive and engage hook elements of the complementary hook material. In particular, a pattern-unbonded nonwoven fabric or web may include a spunbond nonwoven web formed of single component or multi-component melt-spun filaments. At least one surface of the nonwoven fabric can include a plurality of discrete, unbonded areas surrounded or encircled by continuous bonded areas. The continuous bonded areas dimensionally stabilize the fibers or filaments forming the nonwoven web by bonding or fusing together the portions of the fibers or filaments that extend outside of the unbonded areas into the bonded areas, while leaving the fibers or filaments within the unbonded areas substantially free of bonding or fusing. The degree of bonding or fusing within the bonding areas desirably is sufficient to render the nonwoven web non-fibrous within the bonded areas, leaving the fibers or filaments within the unbonded areas to act as "loops" for receiving and engaging hook elements. Examples of suitable point-unbonded fabrics are described in U.S. Patent Application Ser. No. 754,419 entitled PATTERN-UNBONDED NONWOVEN WEB AND PROCESS FOR MAKING THE SAME, by T. J. Stokes et al., and filed December 17, 1996 (attorney docket No. 12,232); the entire disclosure of which is incorporated herein by reference in a manner that is consistent herewith.

In the various configurations of the invention, the loop material need not be limited to a discrete or isolated patch on the outward surface of the article. Instead, the loop material can be provided by a substantially continuous, outer fibrous layer which is assembled, integrated or otherwise joined to extend over a predetermined surface area of the desired article. For example, the outer fibrous layer may be arranged to extend over substantially the total exposed surface area of a cloth-like outer cover employed with the article.

In the various configurations of the invention, the engagement force between the selected first fastener component and its appointed and cooperating second fastener component should be large enough and durable enough to provide an adequate securement of the article on the wearer during use. In particular arrangements, especially where there are sufficiently high levels of engagement shear force provided by the fastening system, the

fastening engagement may provide a peel force value of not less than a minimum of about 40 grams-force (gmf) per inch of the "width" of engagement between the first and second fastener components. In further arrangements, the fastening engagement may provide a peel force value of not less than about 100 gmf/inch to provide improved advantages. In desired configurations, the fastening engagement may provide a peel force value of not less than about 200 gmf per inch of the "width" of engagement between the first and second fastener components . Alternatively, the peel force is not less than about 300 gmf/inch, and optionally is not less than about 400 gmf/inch to further provide improved benefits. In other aspects, the peel force is not more than about 1,200 gmf/inch. Alternatively, the peel force is not more than about 800 gmf/inch, and optionally is not more than about 600 gmf/inch to provide improved performance.

The engagement force between the selected first fastener component and its appointed and cooperating second fastener component may additionally provide a shear force value of not less than about 400 gmf per square inch of the area of engagement between the first and second fastener components. Alternatively, the shear force is not less than about 1,000 gmf/in^2, and optionally, is not less than about 1,700 gmf/in^2. In further aspects, the shear force can be up to about 4,400 gmf/in^2, or more. Alternatively, the shear force is not more than about 3,900 gmf/in^2, and optionally is not more than about 3,500 gmf/in^2 to provide improved performance.

The invention can further be configured to provide an advantageous combination of peel and/or shear forces in the first engagement section 52 and the second engagement section 54 to further improve performance. In particular aspects, the shear force value in the first engagement section 52 is greater than the shear force value in the second engagement section 54, as determined with an applied force directed along the lateral cross-direction 24 toward the medial line 40 of the article. In other aspects, the peel force value provided by the second engagement section 54 can be greater than zero, and less than the peel force value provided by the first engagement section 52. In desired arrangements, the peel force value provided by the second engagement section 54 can be at least a minimum of about 5 grams/inch. Alternatively, the peel force value provided by the second engagement section can be at least about 10 grams/inch, and optionally, can be at least about 20 grams/inch to provide improved performance. In further aspects, the peel force value provided by the second engagement section 54 can be equal to or greater than the peel force value provided by the first engagement section 52.

The peel force value can be determined in accordance with standard procedure ASTM D5170, approved Sept. 15, 1991 and published Nov. 1991; with the following particulars. The test specimen is the fastener tab from the article being assessed. The test specimen length is the dimension aligned along the direction in which a peel-away force is typically applied to disengage and remove the fastener during the ordinary use of the article with which the fastener is employed. The specimen "width" lies within the general plane of the fastener and is perpendicular to the specimen length. The roller device weighs 4.5 pounds and includes a rubber coating around the roller circumference. A suitable roller is part number HR-100 available from Chemsultants International, a business having a location in Mentor, Ohio. During the engagement of the fastener components, the roller is rolled over the test specimen through one cycle in the direction of the cross-wise "width" of the sample. In addition, the initial peel by hand to "raise the loops" is omitted. During testing, the fastener material held by the stationary clamp can be larger in area, as compared to the fastener material held in the moving clamp. The initial separation distance between the clamps of the tensile tester is 4 inch, and the extension speed of the tensile testing machine is 20 inch/min. The reported value of a peel test result is a "three-peak average" value employing MTS TESTWORKS software with a peak criteria of 2%. Additionally, the peel force value is normalized to be stated in terms of force per unit length of the "width" dimension of the fastener component on the test specimen, such as grams per inch. The MTS TESTWORKS software is available from MTS Systems Corporation, a business having offices in Eden Prairie, MN.

The shear force value can be determined in accordance with the standard procedure ASTM D-5169, approved September 15, 1991 and published Nov. 1991 with the following particulars. The test specimen is composed of the fastener tab from the article being assessed. The test specimen length and width typically correspond to the length and width employed to conduct the testing for peel force value. Ordinarily, the test specimen length is the dimension aligned along the direction in which a shear force is typically applied to the fastener during the ordinary use of the article with which the fastener is employed. The specimen "width" lies within the general plane of the fastener and is perpendicular to the specimen length. The roller device weighs 4.5 pounds and includes a rubber coating around the roller. A suitable roller is part number HR-100 available from Chemsultants International, a business having a location in Mentor, Ohio. During the engagement of the fastener components, the roller is rolled over the test specimen through five cycles in the direction of the cross-wise "width" of the sample. In addition, the initial peel by hand to "raise the loops" is omitted. During testing, the fastener material

(e.g. the loop material) held by the stationary clamp can be larger in area, as compared to the fastener material (e.g. hook material) held in the moving clamp. The initial separation distance between the clamps of the tensile tester is 4 inch, and the extension speed of the tensile testing machine is 10 inch/min. The shear force value is normalized to be stated in terms of force per unit area of the test specimen, such as grams per inch^2.

The particulars of the standard test procedures are intended to generate fastening conditions that can be more representative of consumer use conditions. When preparing the test specimen materials (e.g. hook and loop materials) to determine the cooperating peel and/or shear force values for the representatively shown configurations of the invention, it should be noted that, the width dimension of the selected specimen material will correspond to the dimension of the fastener material which, in the actual article, is found to be aligned along the longitudinal direction 26 of the article. Similarly, the length dimension of the selected specimen material will correspond to the dimension of the fastener material which, in the actual article, is found to be aligned along the lateral direction 24 of the article.

Desirably, the securing engagement between the first and second fastener components should be sufficient to prevent a disengagement of the fastener tab 36 away from the landing member 50 when the fastener tab 36 is subject to a tensile force of at least about 1,000 grams when the tensile force is applied outwardly along the lateral direction, aligned generally parallel with the plane of the backsheet layer 30 of the article.

Each of the fastener components and fastening elements in the various constructions of the invention may be operably attached to its supporting substrate by employing any one or more of the attachment mechanisms employed to construct and hold together the various other components of the article of the invention. The fastening elements in the various fastening regions, may be integrally formed, such as by molding, co-extrusion or the like, along with their associated substrate layer. The substrate layer and its associated mechanical fastening elements may be formed from substantially the same polymer material, and there need not be a discrete step of attaching the fastening elements to an initially separate substrate layer. For example, the individual hook elements may be integrally formed simultaneously with a hook base-layer by coextruding the base layer and hook elements from substantially the same polymer material.

It should be readily appreciated that the strength of the attachment or other interconnection between the substrate layer and the attached fastening component should be greater than the peak force required to remove the fastener tab 36 from its releasable securement to the appointed landing member of the article.

Examples

The following examples are presented to provide a more detailed understanding of the invention, and are not intended to specifically limit the scope of the invention.

Peel testing was conducted employing VELCRO HTH-840 hook material and GUILFORD loop material. The VELCRO HTH-840 hook material was a 100% uni-directional molded hook material which included prong-type hooks having 0.028 inch hook height, 0.008 inch hook width, and a hook density of 900 hooks/in^2 (140 hooks/cm^2). The GUILFORD loop material was a blue loop material fabric composed of a 2 bar, warp knit fabric of the type available from Guilford Mills, Inc., Greensboro, North Carolina under the trade designation #36549.

Peel testing was performed on the raw materials in accordance with ASTM #D5170-91, "Standard Test Method for Peel Strength ("T" Method) of Hook and Loop Touch Fasteners", with the following modifications:

- 6.2.1: A 25 pound load cell was used. As a result, the test values fell below 20% of full scale range.
- 8.1.1: The hook and loop materials were both supplied in 6 inch wide rolls, and all samples were cut in the desired hook orientation to measure 6 inch long by 1 inch wide.
- 8.1.3: All test samples measured 6 inch in sample length by 1 inch in sample width. The samples of loop material were tested in the cross-direction so that orientation of the loop material during testing would match the orientation of loop material when employed in the article. The loop orientation was kept constant for maximum consistency, and the hook prongs were oriented as appropriate for each example code. The number of individual samples for all codes was n = 10.
- 10.1 & 10.2.4.1: The closure engagement of the sample hook and loop materials was not made and separated by hand to raise the loops prior to performing the test, since the dimensional stability of the loop is low (the loop stretches/necks during peel). The actual test was conducted and the results were recorded during the first time that the samples were engaged.

- 11.1 through 11.1.3: The MTS TESTWORKS software used during the testing calculates the average of the 5 highest peaks selected per a specified peak criteria (5%). These were not necessarily the highest single peaks found in each of 5 successive equal portions of the peel curve.

The testing provided relative peel force values between the different example codes. The values may not be directly comparable to the desired fastener peel values previously described in the specification due to differences in the testing procedure. For example, in the testing of the examples, the weighted roller was heavier and was rolled through 5 cycles along the length direction of the sample.

The Example Codes (hook orientations) tested were as follows:

- "Inboard": all hook prongs oriented perpendicular to and facing inboard toward the medial line of the article.
- "Outboard": all hook prongs oriented perpendicular to and facing outboard away from the medial line of the article.
- "MD-Up": all hook prongs oriented parallel to the medial line of article and facing up, away from the intermediate, crotch portion of the article.
- "MD-Down": all hooks oriented parallel to the medial line of article and facing down, toward the intermediate, crotch portion of the article.

It was expected that the "MD-Up" and "MD-Down" hook orientations would give the same test results. When testing, however, these hook orientations provided different results for the particular hook samples used. The reason is unknown, but may be due to some slight directionality to the hooks (e.g. leaning of the hooks) imparted during or after manufacturing. Since they were different, they were treated as separate codes, but another line in the data table shows an average of the "MD-Up" and "MD-Down" peel values. This average could be interpreted to represent either a "typical" MD peel value, or a case in which the MD hooks were 50/50 bi-directional, with 50% of the hook prongs directed in the "up" direction and 50% of the hook prongs directed in the "down" direction.

The testing results are summarized in the following TABLE 1.

TABLE 1

Hook Orientation	5-Peak Load (grams/inch)				Avg. Load (grams/inch)			
	Mean	Stdv	%COV	n*	Mean	Stdv	%COV	n
Inboard	75	6	8	6	26	5	17	10
MD - Down	177	42	24	10	82	21	25	10
MD - Up	381	44	12	10	209	31	15	10
*MD - Avg.***	*279*	*113*	*41*	*20*	*146*	*70*	*48*	*20*
Outboard	500	49	10	10	264	41	16	10

* Number of the 10 specimens for which 5 peaks were detected, using 5% peak criteria.

** Averaged data for "MD-Down" and "MD-Up".

Stdv = standard deviation.

%COV = percent covariance.

The data from the examples show that engagement hook members having their engagement prongs directed outboard, away from the direction of the applied peel force would ordinarily provide a peel force value which is greater than the peel force value provided by hook members having their engagement prongs directed perpendicular to the applied peel force, and also greater than the peel force value provided by hook members having their engagement prongs directed inboard, in the direction of the applied peel force. Similarly, the data from the examples would indicate that engagement hook members having their engagement prongs directed perpendicular to the applied peel force would also provide a peel force value which is greater than the peel force value provided by hook members having their engagement prongs directed inboard, in the direction of the applied peel force. Accordingly, the data suggests that the various configurations of the invention would not contribute to an ease of removal and refastening of the fastener tab.

Contrary to such ordinary expectations, however, actual users have reported that the configurations of the invention unexpectedly make it easier for the user to find and disengage the fastener tab from its appointed landing zone attachment. While not intending to be bound by any particular theory, it is believed that the particular combination of the peel strength value and low shear force value provided by the second engagement section of the invention advantageously contribute to the improved ease of removal and refastening.

Having described the invention in rather full detail, it will be readily apparent that various changes and modifications can be made without departing from the spirit of the invention. All of such changes and modifications are contemplated as being within the scope of the invention as defined by the subjoined claims.

We claim:

1. An article, having a lengthwise longitudinal direction, a lateral cross-direction, and a longitudinally extending medial line, said article comprising:

a first article portion; a second article portion; and at least one fastener for securing said first article portion to said second article portion;

said fastener including at least one first fastener component attached to an appointed section of said first article portion, and a cooperating, second fastener component attached to said second article portion; wherein

said first fastener component includes a first engagement section having a first plurality of engagement members, and a second engagement section having a second plurality of engagement members;

each engagement member has a stem portion with a distal end region, and has a securement element disposed at said distal end region of its corresponding stem portion,

said first plurality of engagement members has a first arrangement pattern of their securement elements; and

said second plurality of engagement members has a second arrangement pattern of their securement elements, with said second arrangement pattern differing from said first arrangement pattern.

2. The article as recited in claim 1, wherein

said first engagement section includes a first plurality of non-isotropic engagement members, and said second engagement section includes a second plurality of non-isotropic engagement members;

each non-isotropic engagement member has a stem portion with a distal end region, and a non-isotropic securement element disposed at said distal end region of its corresponding stem portion to provide a non-isotropic engagement opening;

said first plurality of non-isotropic engagement members has a first alignment pattern of their engagement openings; and

said second plurality of non-isotropic engagement members has a second alignment pattern of their engagement openings, with said second alignment pattern differing from said first alignment pattern.

3. The article as recited in claim 1, wherein

said first engagement section includes a first plurality of non-symmetric engagement members, and said second engagement section includes a second plurality of non-symmetric engagement members;

each non-symmetric engagement member has a stem portion with a distal end region, and a securement element asymmetrically disposed at said distal end region of its corresponding stem portion to provide an asymmetric engagement opening;

said first plurality of non-symmetric engagement members has a first alignment pattern of their engagement openings; and

said second plurality of non-symmetric engagement members has a second alignment pattern of their engagement openings, with said second alignment pattern differing from said first alignment pattern.

4. The article as recited in claim 1, wherein

said first engagement section includes a first plurality of non-isotropic engagement members, and said second engagement section includes a second plurality of non-symmetric engagement members;

each non-isotropic engagement member has a stem portion with a distal end region, and a non-isotropic securement element disposed at said distal end region of its corresponding stem portion to provide a non-isotropic engagement opening;

each non-symmetric engagement member has a stem portion with a distal end region, and a securement element asymmetrically disposed at said distal end region of its corresponding stem portion to provide an asymmetric engagement opening;

said first plurality of non-isotropic engagement members has a first alignment pattern of their non-isotropic engagement openings; and

said second plurality of non-symmetric engagement members has a second alignment pattern of their non-symmetric engagement openings, with said second alignment pattern differing from said first alignment pattern.

5. The article as recited in claim 1, wherein

said first engagement section includes a first plurality of non-symmetric engagement members, and said second engagement section includes a second plurality of non-isotropic engagement members;

each non-isotropic engagement member has a stem portion with a distal end region, and a non-isotropic securement element disposed at said distal end region of its corresponding stem portion to provide a non-isotropic engagement opening;

each non-symmetric engagement member has a stem portion with a distal end region, and a securement element asymmetrically disposed at said distal end region of its corresponding stem portion to provide an asymmetric engagement opening;

said first plurality of non-symmetric engagement members has a first alignment pattern of their engagement openings; and

said second plurality of non-isotropic engagement members has a second alignment pattern of their engagement openings, with said second alignment pattern differing from said first alignment pattern.

6. The article as recited in claim 1, wherein said first engagement section is positioned laterally inboard from said second engagement section.

7. The article as recited in claim 1, wherein at least about 60% of said first plurality of engagement members are oriented with their engagement openings directed relatively inboard of the article, and at least about 60% of said second plurality of engagement members are oriented with their engagement openings directed relatively outboard of the article.

8. The article as recited in claim 1 , wherein said first article portion provides a first waistband portion; said second article portion provides a second waistband portion; said article has an intermediate portion which interconnects said first and second waistband portions; and wherein said article further comprises:

a backsheet layer;

a substantially liquid-permeable topsheet layer; and

an absorbent body sandwiched between said backsheet layer and topsheet layer.

9. An article, having a lengthwise longitudinal direction, a lateral cross-direction, and a longitudinally extending medial line, said article comprising:

a first article portion; a second article portion; and at least one fastener for securing said first article portion to said second article portion;

said fastener including at least one first fastener component attached to an appointed section of said first article portion, and a cooperating, second fastener component attached to said second article portion; wherein

said first fastener component includes a first engagement section having a first plurality of non-isotropic engagement members, and a second engagement section having a second plurality of non-isotropic engagement members;

each non-isotropic engagement member has a stem portion with a distal end region, and has a non-isotropic securement element disposed at said distal end region of its corresponding stem portion,

said first plurality of non-isotropic engagement members has a first alignment pattern of their securement elements; and

said second plurality of non-isotropic engagement members has a second alignment pattern of their securement elements, with said second alignment pattern differing from said first alignment pattern.

10. The article as recited in claim 9, wherein said first engagement section is positioned laterally inboard from said second engagement section.

11. The article as recited in claim 9, wherein at least about 60% of said first plurality of engagement members are oriented with their engagement openings directed substantially along said lateral cross-direction, and at least about 60% of said second plurality of engagement members are oriented with their engagement openings directed substantially along said longitudinal direction.

12. The article as recited in claim 9, wherein

said securement element of said each non-isotropic engagement member is configured to provide a non-isotropic engagement opening;

a majority of said first plurality of non-isotropic engagement members have a primary portion of their non-isotropic engagement openings directed substantially along a first vector which has a first, cross-directional vector-component directed along said lateral cross-direction;

a majority of said second plurality of non-isotropic engagement members have a primary portion of their non-isotropic engagement openings directed substantially along a second vector which is directed away from said first cross-directional vector-component by an offset angle which is at least about ± 45 degrees.

13. The article as recited in claim 12, wherein said offset angle is not more than about ± 90 degrees.

14. The article as recited in claim 9, wherein a peel force value provided by said second engagement section is greater than zero, and a shear force value provided by said first engagement section is greater than a shear force value provided by said second engagement section, as determined with a tensile force applied along said lateral cross-direction toward said medial line of the article.

15. The article as recited in claim 9 , wherein said first article portion provides a first waistband portion; said second article portion provides a second waistband portion; said article has an intermediate portion which interconnects said first and second waistband portions; and wherein said article further comprises:

a backsheet layer;

a substantially liquid-permeable topsheet layer; and

an absorbent body sandwiched between said backsheet layer and topsheet layer.

16. An article, having a lengthwise longitudinal direction, a lateral cross-direction, and a longitudinally extending medial line, said article comprising:

a first article portion; a second article portion; and at least one fastener for securing said first article portion to said second article portion;

said fastener including at least one first fastener component attached to an appointed section of said first article portion, and a cooperating, second fastener component attached to said second article portion; wherein

said first fastener component includes a first engagement section having a first plurality of non-symmetric engagement members, and a second engagement section having a second plurality of non-symmetric engagement members;

each non-symmetric engagement member has a stem portion with a distal end region, and has a non-symmetric securement element disposed at said distal end region of its corresponding stem portion,

said first plurality of non-symmetric engagement members has a first alignment pattern of their securement elements; and

said second plurality of non-symmetric engagement members has a second alignment pattern of their securement elements, with said second alignment pattern differing from said first alignment pattern.

17. The article as recited in claim 16, wherein said first engagement section is positioned laterally inboard from said second engagement section.

18. The article as recited in claim 16, wherein at least about 60% of said first plurality of engagement members are oriented with their engagement openings directed relatively inboard of the article, and at least about 60% of said second plurality of engagement members are oriented with their engagement openings directed relatively outboard of the article.

19. The article as recited in claim 16, wherein

said securement element of said each non-symmetric engagement member is configured to provide a non-symmetric engagement opening;

a majority of said first plurality of non-symmetric engagement members have a primary portion of their non-symmetric engagement openings directed substantially along a first vector which has a first, cross-directional vector-component directed along said lateral direction and toward said medial line of the article;

a majority of said second plurality of non-symmetric engagement members have a primary portion of their non-symmetric engagement openings directed substantially along a second vector which is directed away from said first cross-directional vector-component by an offset angle which is at least about ± 45 degrees.

20. The article as recited in claim 19, wherein said offset angle is not more than about ± 180 degrees.

21. The article as recited in claim 16, wherein a peel force value provided by said second engagement section is greater than zero, and a shear force value provided by said first engagement section is greater than a shear force value provided by said second engagement section, as determined with a tensile force applied along said lateral cross-direction toward said medial line of the article.

22. The article as recited in claim 16, wherein said first article portion provides a first waistband portion; said second article portion provides a second waistband portion; said article has an intermediate portion which interconnects said first and second waistband portions; and wherein said article further comprises:

a backsheet layer;

a substantially liquid-permeable topsheet layer; and

an absorbent body sandwiched between said backsheet layer and topsheet layer.

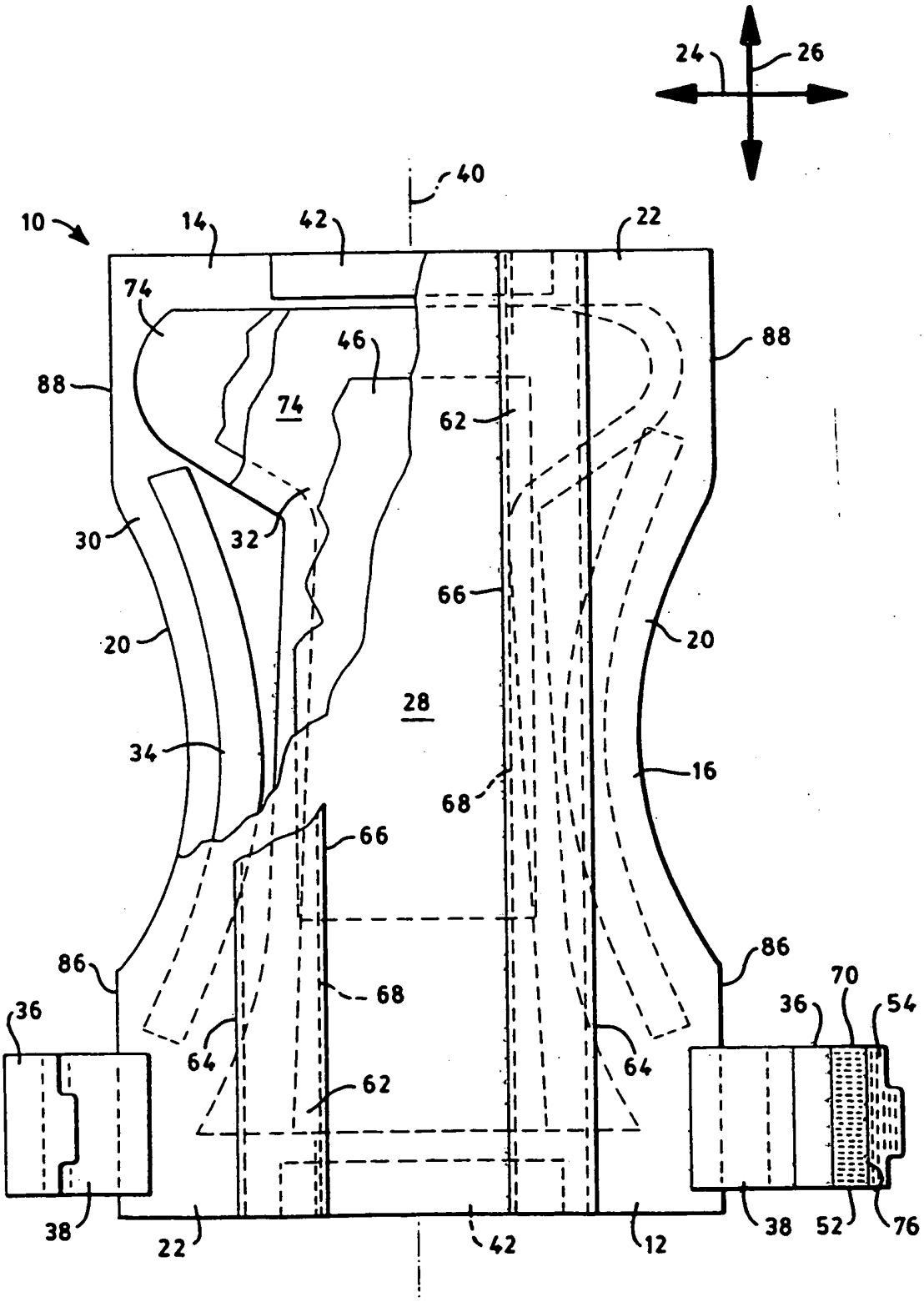
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FIG. 1

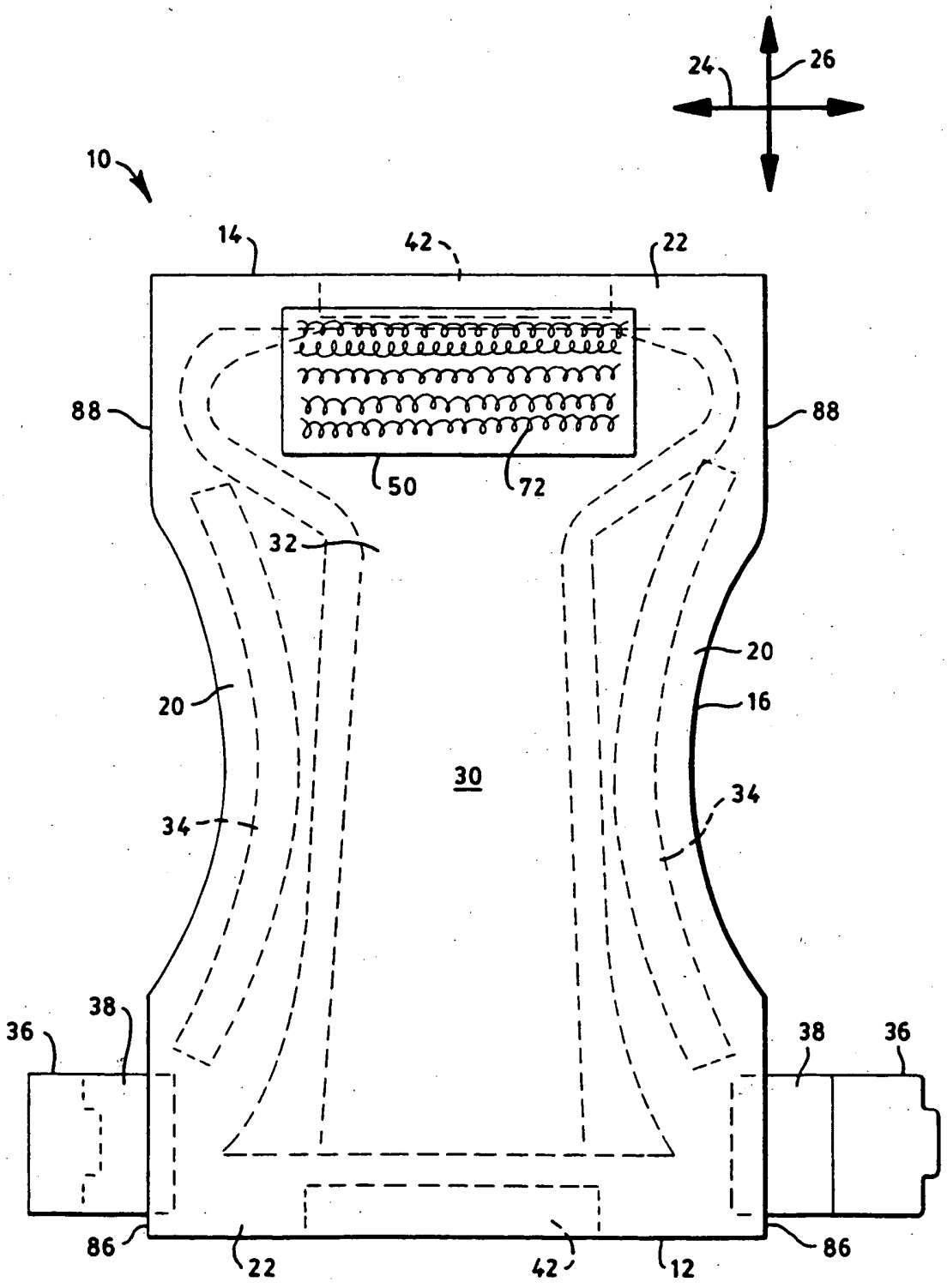
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FIG. 2

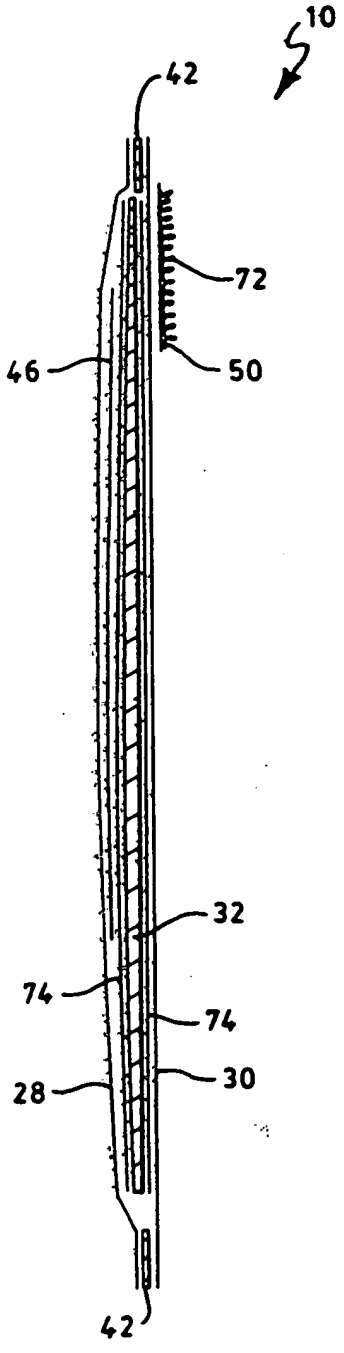

FIG. 3

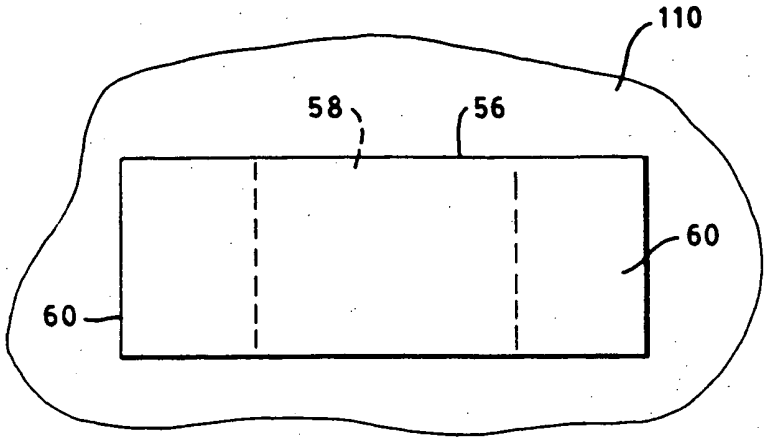

FIG. 4A

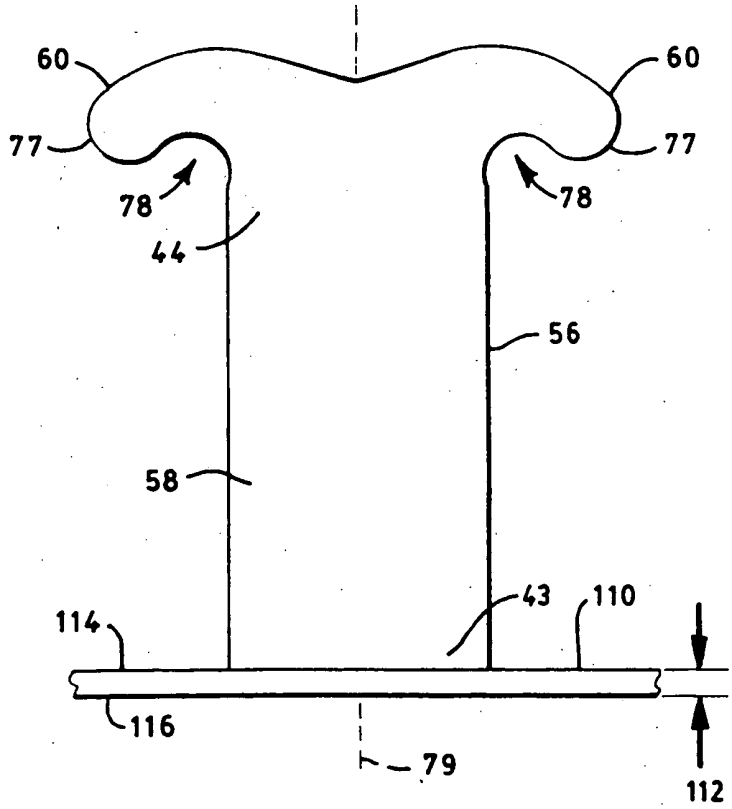

FIG. 4

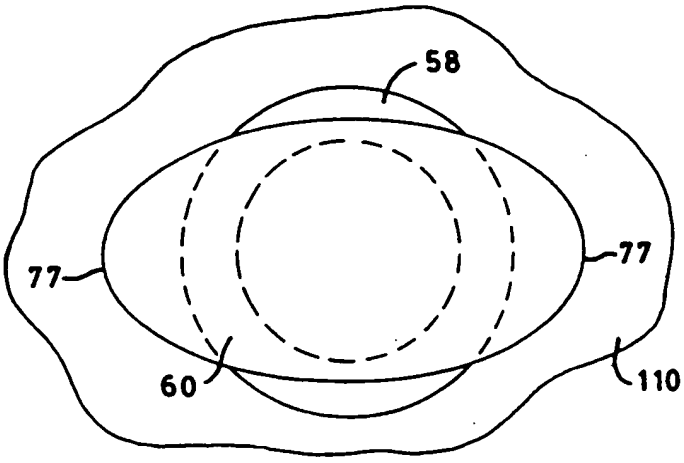

FIG. 5A

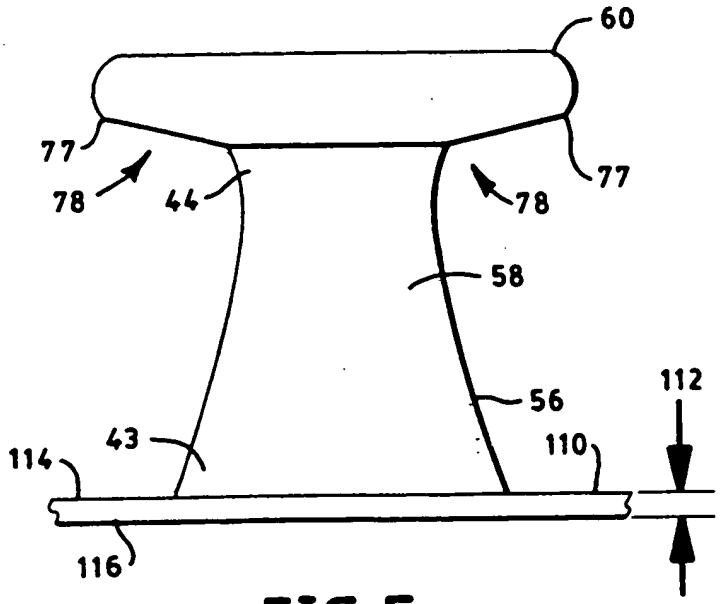

FIG. 5

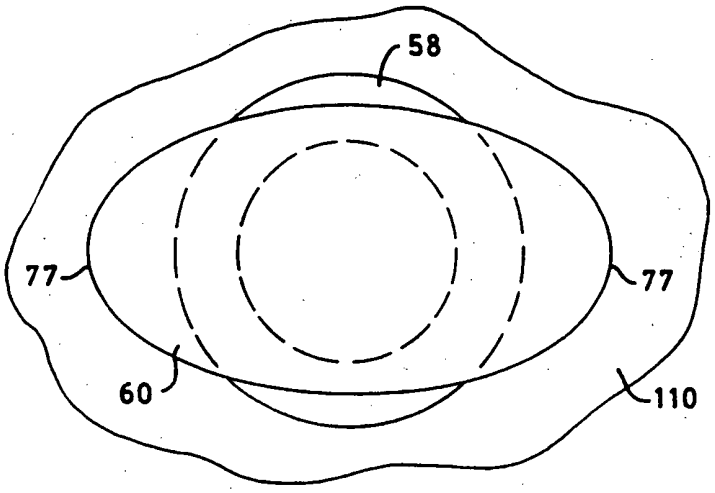

FIG. 6A

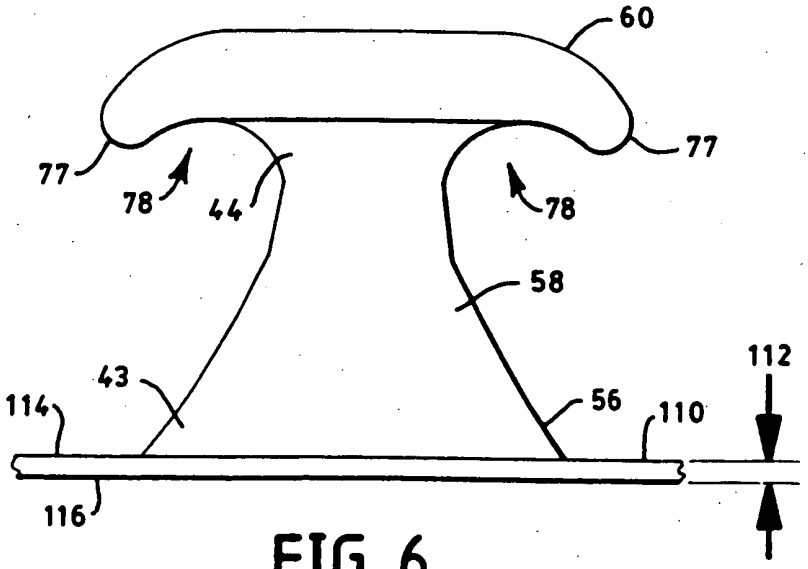

FIG. 6

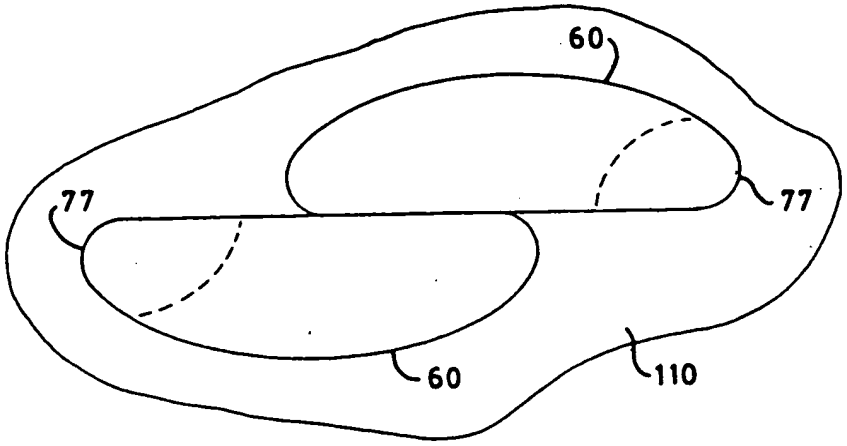

FIG. 7A

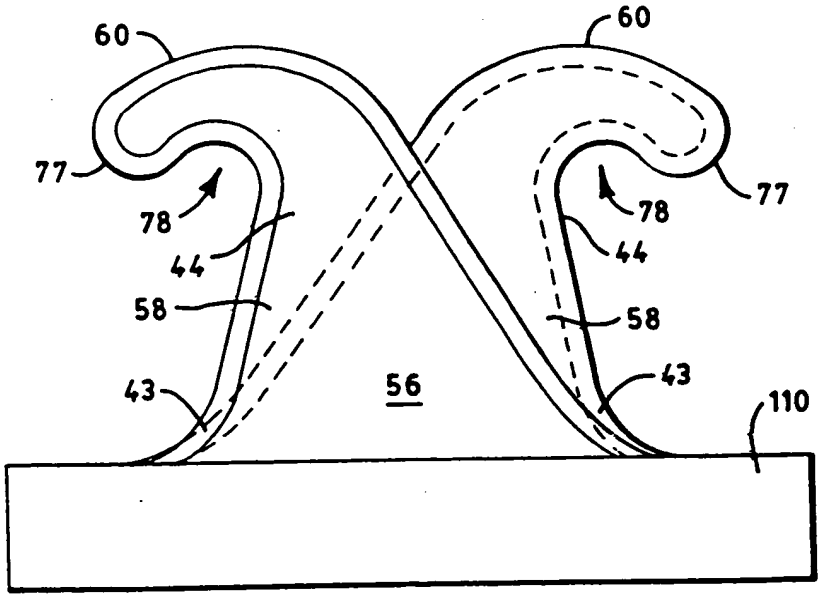

FIG. 7

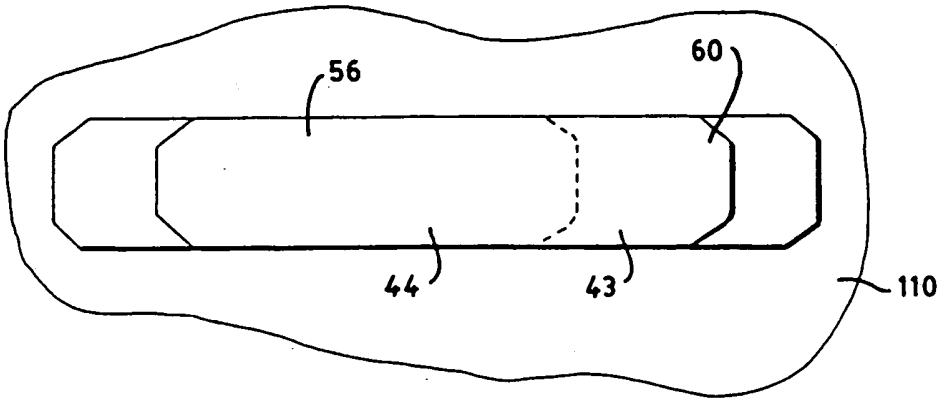

FIG. 8A

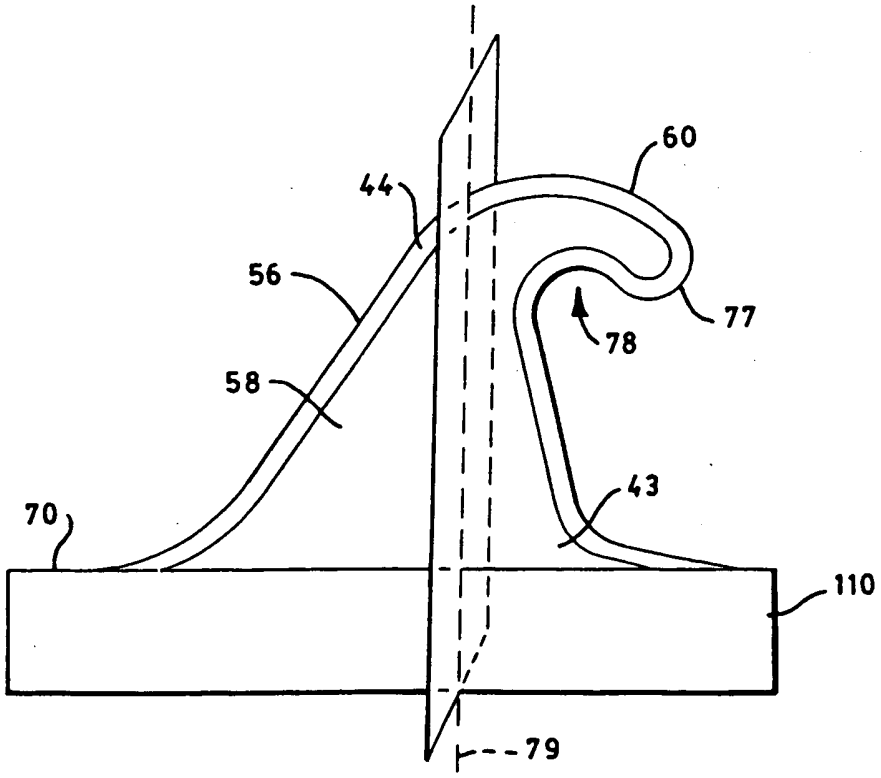

FIG. 8

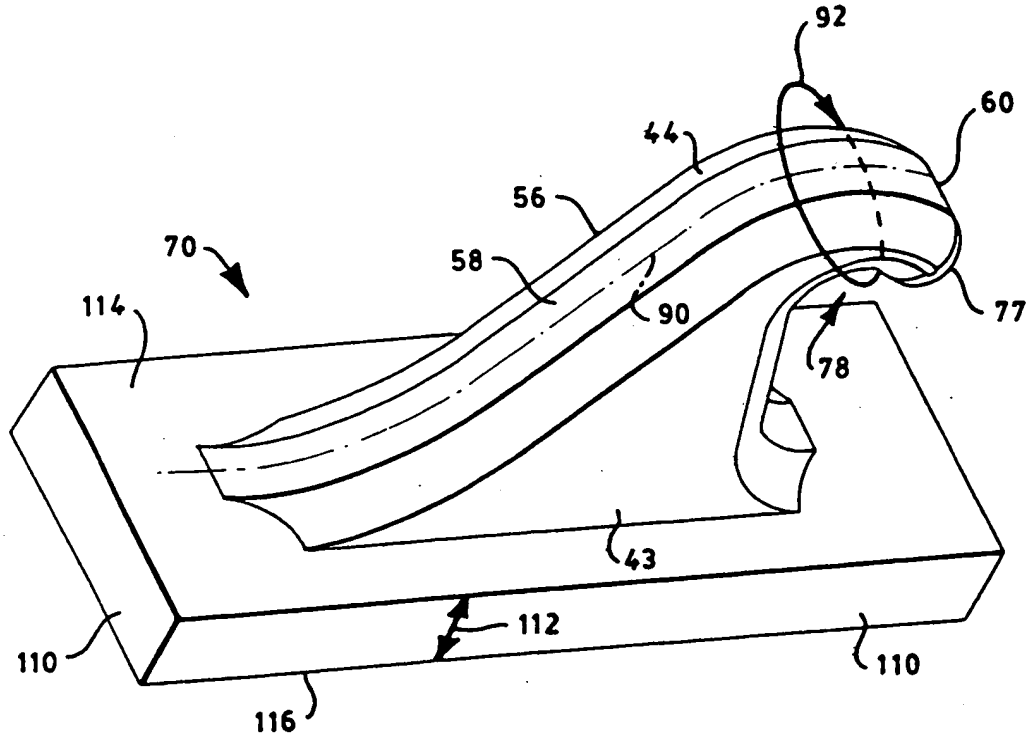

FIG. 9

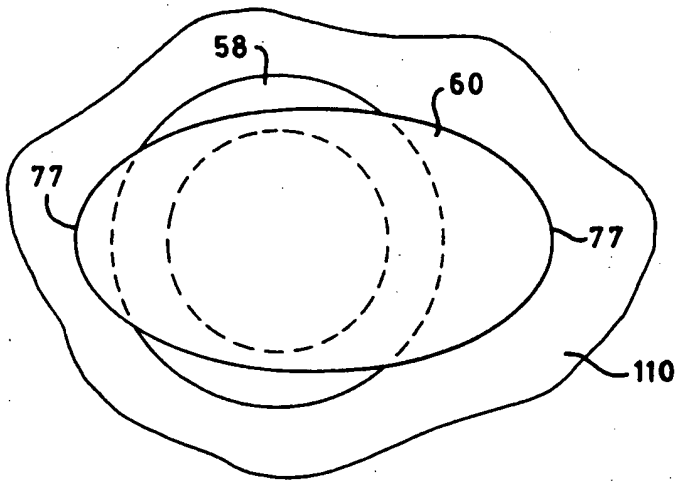

FIG. 10A

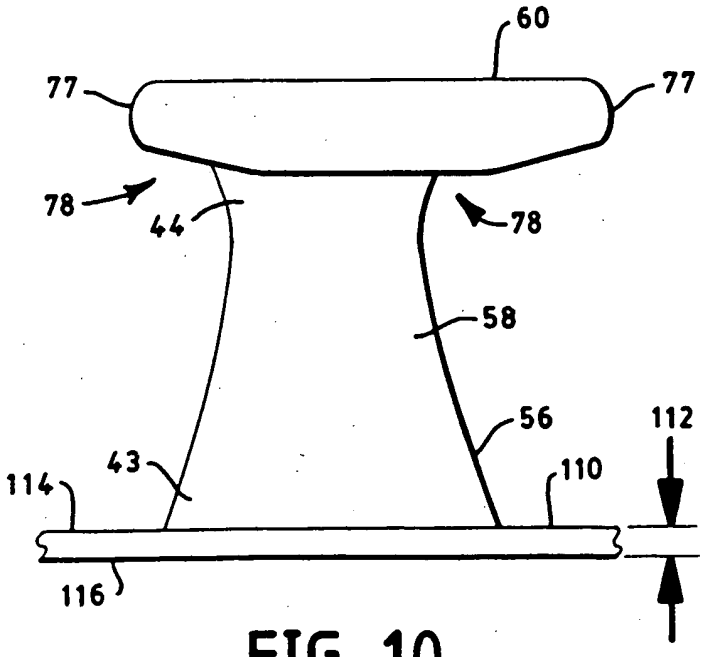

FIG. 10

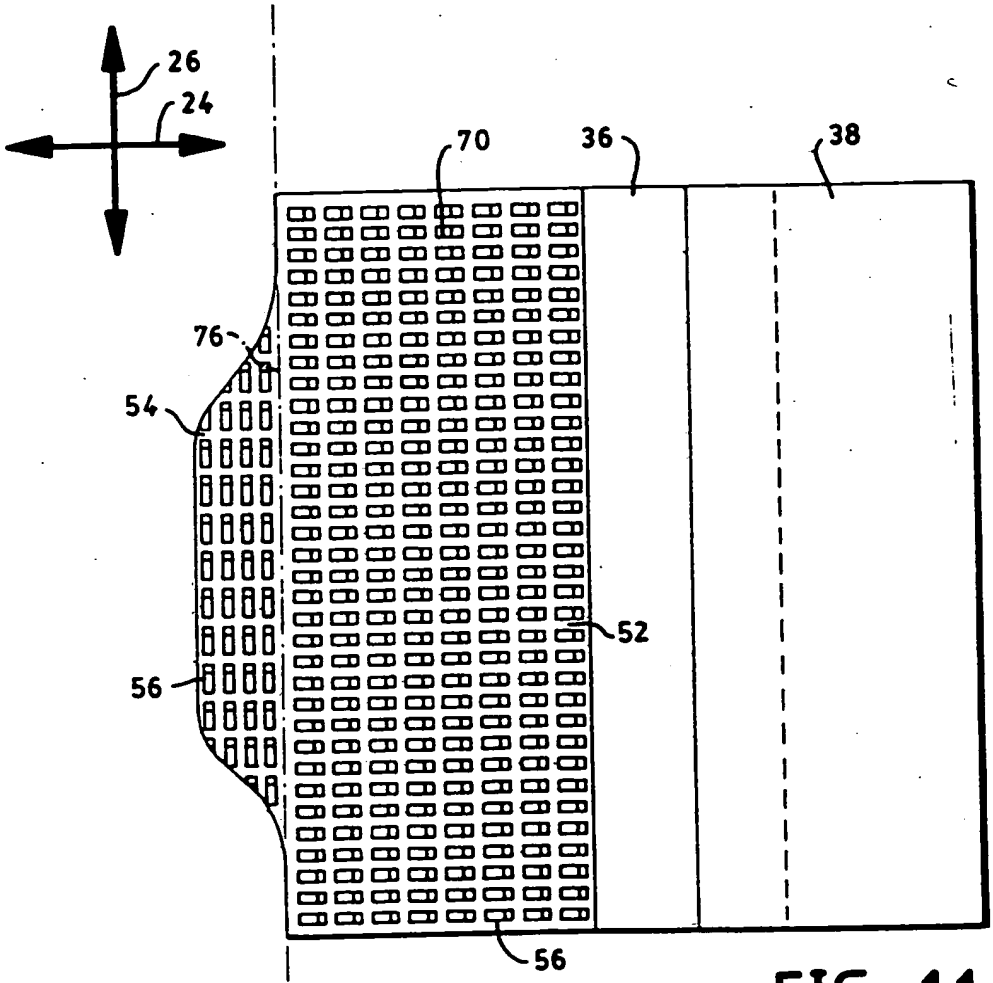

FIG. 11

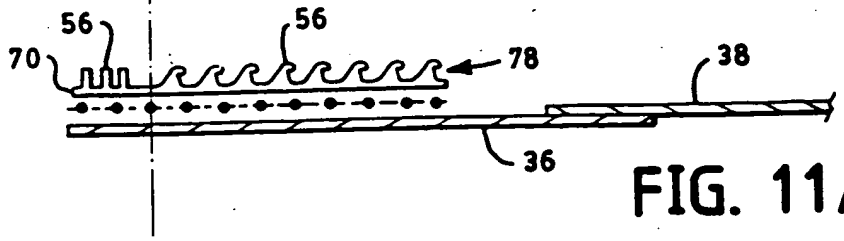

FIG. 11A

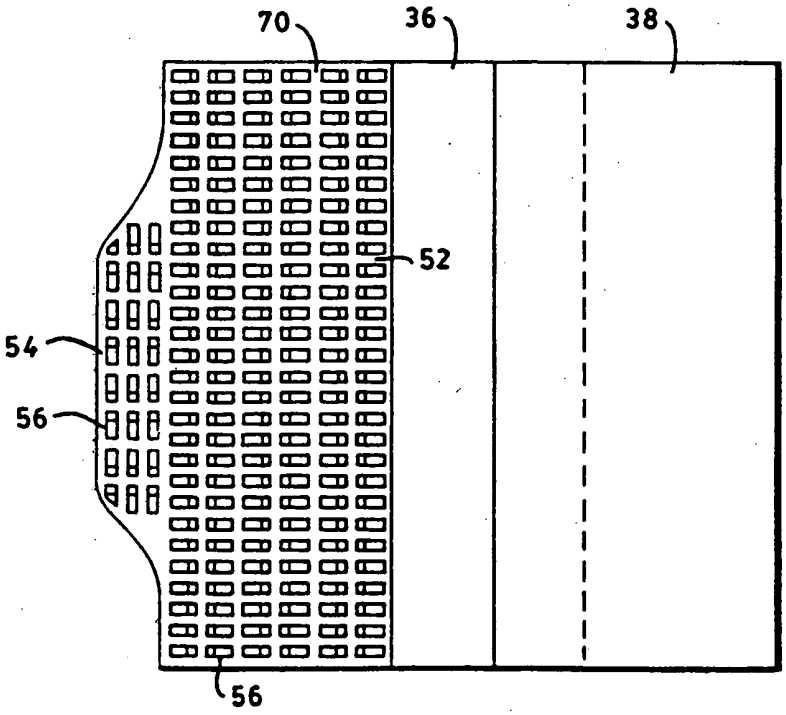

FIG.11B

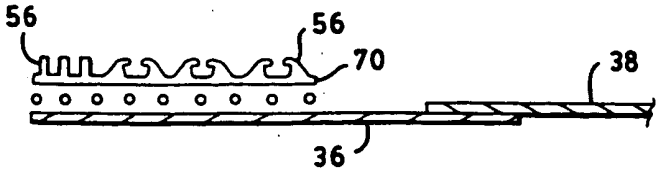

FIG. 11C

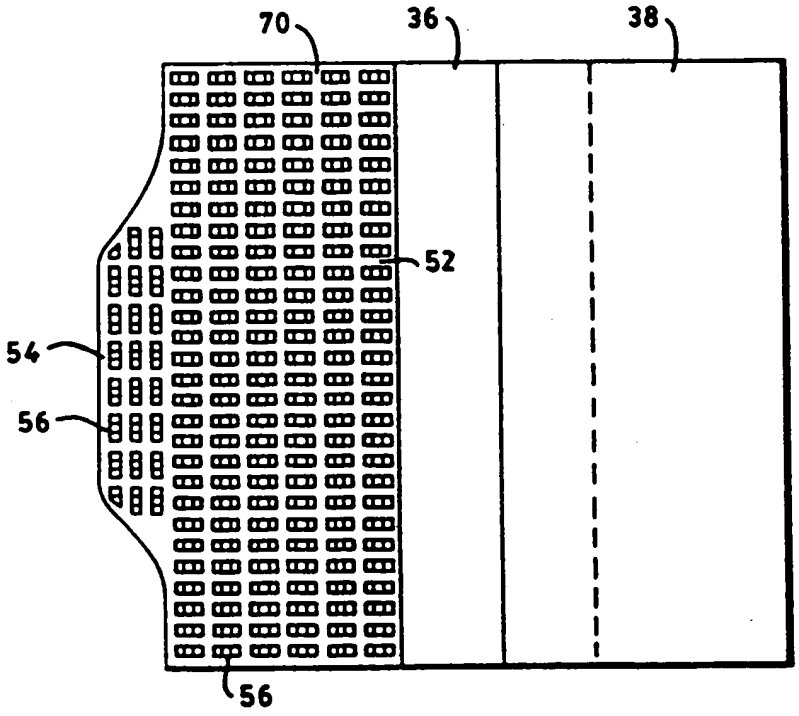

FIG.11D

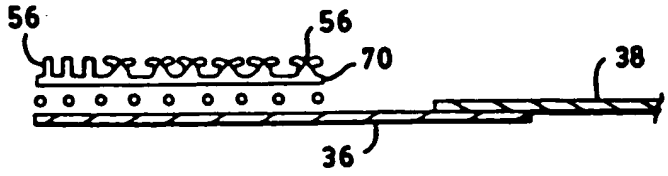

FIG. 11E

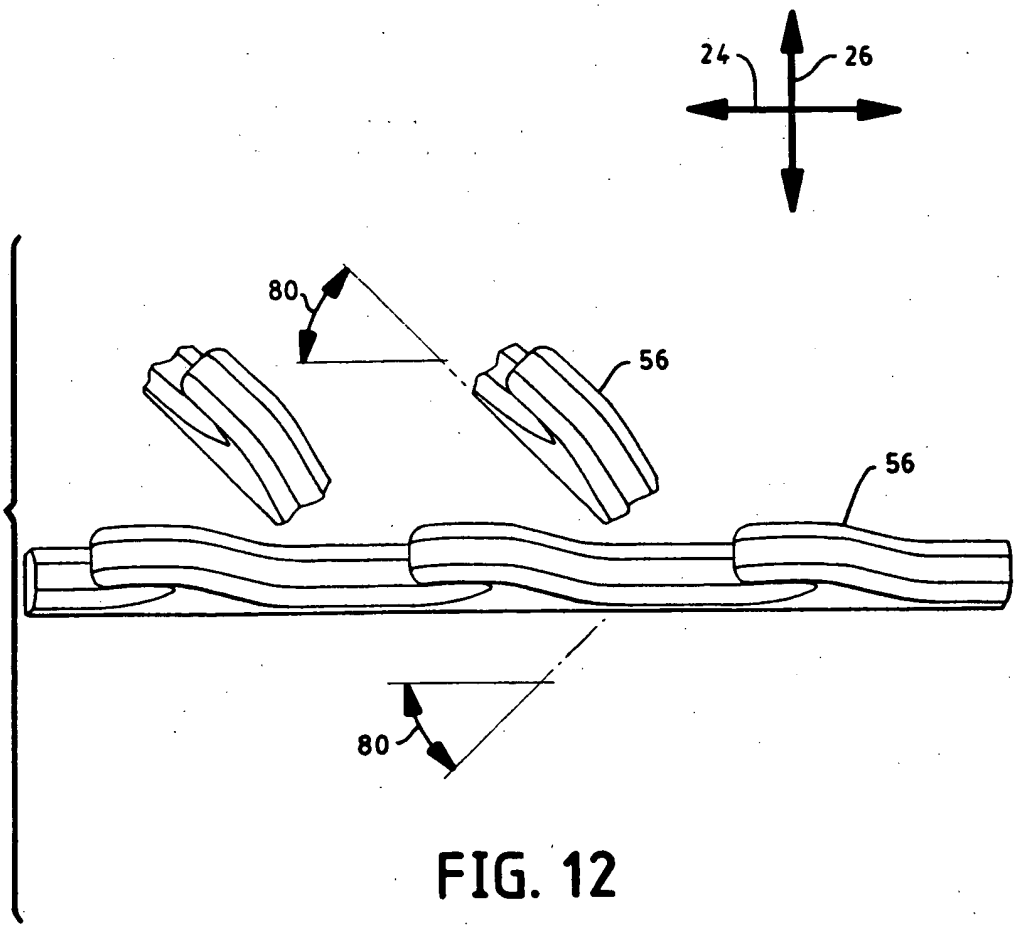

FIG. 12

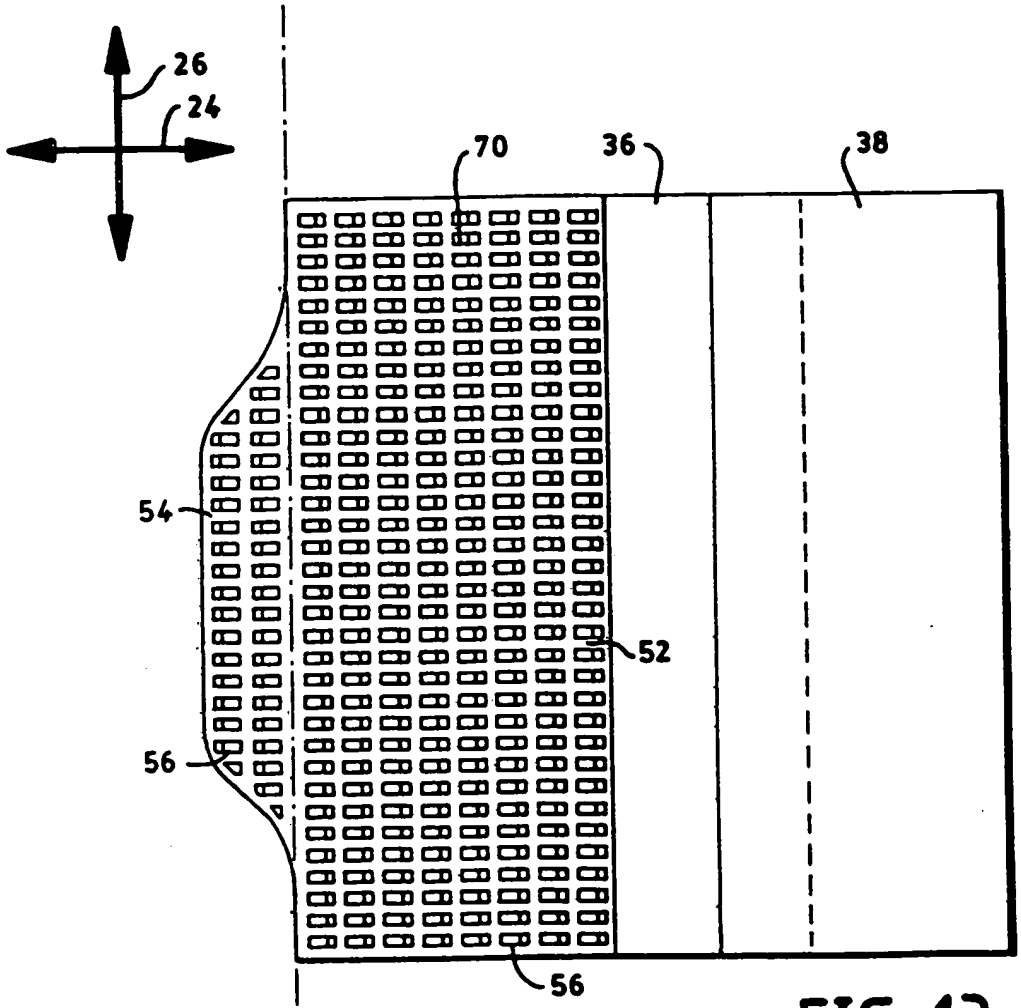

FIG. 13

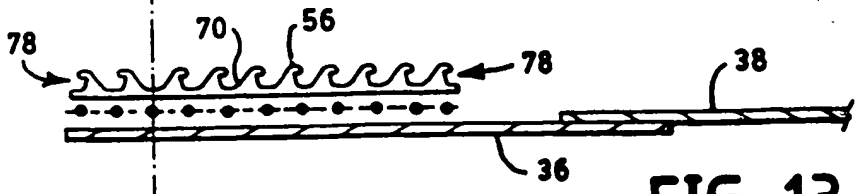

FIG. 13A

INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/US 99/21495

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A44B18/00 A61F13/62

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A44B A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 624 429 A (LONG ANDREW M ET AL) 29 April 1997 (1997-04-29) cited in the application column 2, line 48-64; figures 1,3,4 column 15, line 45-67	1,6-8
A	---	2-5,9-22
A	EP 0 711 518 A (YKK CORP) 15 May 1996 (1996-05-15) column 3, line 37 -column 4, line 3 column 3, line 4-9 figures	1-22
A	---	1-22
	EP 0 809 952 A (YKK CORP) 3 December 1997 (1997-12-03) abstract; figures	

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 January 2000	04/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kock, S

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INTERNATIONAL SEARCH REPORT

In: tional Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 94 23610 A (MINNESOTA MINING & MFG) 27 October 1994 (1994-10-27) page 1, line 6-12 page 3, line 29 -page 4, line 3 figures -----	1-22

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